This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

**Usage guidelines**

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

**About Google Book Search**

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

WENTWORTH AND HILL'S

# Examination Manua

No. I.

## ARITHMETIC.

EducT 118.84.88.2

HARVARD COLLEGE
LIBRARY

THE ESSEX INSTITUTE
TEXT-BOOK COLLECTION

GIFT OF

GEORGE ARTHUR PLIMPTON

OF NEW YORK

JANUARY 25, 1924

3 2044 097 001 408

WENTWORTH & HILL'S

# EXAMINATION MANUALS.

No. I.

---

## ARITHMETIC.

---

BOSTON:
GINN, HEATH, & COMPANY.
1884.

due T/118.84.880.

HARVARD COLLEGE LIBRARY

Entered, according to Act of Congress, in the year 1883,
BY GEORGE A. WENTWORTH AND GEORGE A. HILL,
In the Office of the Librarian of Congress at Washington.

J. S. CUSHING & CO., PRINTERS, BOSTON.

# PREFACE.

THIS Manual consists of two parts: The first part contains one hundred and fifty examination papers, the questions for which have been selected mainly from the English, French, and German collections of problems. These papers may be divided into three groups. The first fifty papers are confined to the Simple Rules, Fractions, and Weights and Measures; the next fifty papers cover all the subjects treated in ordinary text-books except the Metric System; the last fifty also include the Metric System.

In each group the earlier papers will be found somewhat easier than the later ones. The papers are intended to be *hour* papers, but if any of them are thought to be too long for one hour, the time may be increased, or the length of the paper reduced by omitting one or more questions.

The second part of the Manual is a collection of recent examination papers actually set in various American and English institutions of learning.

The Manual may be used in two ways.

First: To *test* the learner's knowledge in the usual way by means of an examination. For this purpose the class will come to the recitation-room provided with the Manual and blank books, and the teacher will simply designate by number the paper to be worked.

Secondly: To *review* the subject-matter of Arithmetic. This may be done by assigning problems to be worked in the class-room,

or by assigning to each pupil a paper with directions to hand in the solutions, neatly worked out, at a subsequent recitation.

The Manual will be found especially useful in preparing for written examinations.

Answers to the problems in the first one hundred and fifty papers, bound separately in paper covers, can be had by teachers *only*, on application to the publishers.

G. A. WENTWORTH.
G. A. HILL.

# SPECIMEN PAPER WORKED OUT.

**1.** In 674,381 inches how many miles, furlongs, rods, etc.?

12)674381 in.
3)56198 ft. 5 in.
18732 yds. 2 ft.
2
11)37464 half-yds.
40)3405 rds. 4½ yds.
8)85 fur. 5 rds.
10 mi. 5 fur.

10 mi. 5 fur. 5 rds. 4½ yds. 2 ft. 5 in.

*Ans.* 10 mi. 5 fur. 5 rds. 5 yds. 0 ft. 11 in.

**2.** Find the G.C.M. of 269,178 and 352,002.

6)269178 352002
44863 )58667(1
44863
4)13804
3451)44863(13
3451
10353
10353

*Ans.* $6 \times 3451 = 20{,}706$.

The common factor 6 is first taken out from both numbers. From the remainder 13,804, the factor 4, which is prime to 44,863, is ejected. The resulting number 3451 is contained 13 times in 44,863, and therefore the greatest common measure is $6 \times 3451 = 20{,}706$.

3. Simplify $\dfrac{\frac{1}{3}+\frac{2}{11}+\frac{7}{24}-\frac{1}{3}\text{ of }\frac{2}{11}\text{ of }\frac{7}{24}}{1-\frac{1}{3}\text{ of }\frac{2}{11}-\frac{2}{11}\text{ of }\frac{7}{24}-\frac{7}{24}\text{ of }\frac{1}{3}}.$

$$\frac{1}{3}\text{ of }\frac{2}{11}\text{ of }\frac{7}{24} = \frac{7}{396};$$
(24 cancelled to 12)

$$\frac{1}{3}+\frac{2}{11}+\frac{7}{24}-\frac{7}{396} = \frac{264+144+231-14}{792} = \frac{625}{792};$$

$$\frac{1}{3}\text{ of }\frac{2}{11} = \frac{2}{33};\quad \frac{2}{11}\text{ of }\frac{7}{24} = \frac{7}{132};\quad \frac{7}{24}\text{ of }\frac{1}{3} = \frac{7}{72};$$
(24 cancelled to 12)

$$1-\frac{2}{33}-\frac{7}{132}-\frac{7}{72} = \frac{792-48-42-77}{792} = \frac{625}{792};$$

$$\frac{625}{792} \div \frac{625}{792} = 1.$$

*Ans.* 1.

4. Divide 0.025 by 500, and 0.03625 by 0.29.

```
5ØØ)0.025ØØ          0.125
    0.00005      29)3.625
                    29
                     72
                     58
                    145
                    145
```

0.00005, 0.125. *Ans.*

5. Make out the following bill:

3¼ pounds of tea at 64 cents per pound;
1½ pounds of coffee at 40 cents per pound;
6½ pounds of loaf sugar at 10 cents per pound;
1½ pounds of butter at 34 cents per pound.

How much change out of $5 should Mr. Smith receive?

Mr. JOHN SMITH,

Dr. to JAMES HORN.

| | | | |
|---|---|---|---|
| 1883. | | | |
| Aug. 17. | 3¼ lbs. of tea | @ 64 cts. . . . | $2.08 |
| | 1½ lbs. of coffee | @ 40 cts. . . . | .60 |
| | 6½ lbs. of sugar | @ 10 cts. . . . | .65 |
| | 1½ lbs. of butter | @ 34 cts. . . . | .51 |
| | | | $3.84 |

Received payment,

JAMES HORN.

*Ans.* $5.00 – $3.84 = $1.16.

**6.** If 18 men can dig a trench 200 yards long, 3 yards wide, and 2 yards deep, in 6 days of 10 hours each, in how many days of 8 hours each will 10 men dig a trench 100 yards long, 4 yards wide, and 3 yards deep?

Men, 10 : 18 :: 6 days.
Length, 200 : 100
Width, 3 : 4
Depth, 2 : 3
Hours, 8 : 10

$$\frac{\cancel{18}^{9} \times \cancel{100}^{\cancel{200}} \times \cancel{4}^{\cancel{2}} \times \cancel{3} \times \cancel{10} \times \cancel{3}}{\cancel{10} \times \cancel{200}^{\cancel{2}} \times \cancel{3} \times \cancel{2} \times \cancel{3}_{2}} = \frac{27}{2} = 13\tfrac{1}{2}.$$

*Ans.* $13\frac{1}{2}$ days.

**7.** What alteration will be made in an income by selling \$10,000 of 4 per cent stock at $89\frac{1}{4}$, and buying 5 per cent stock at 105?

Income from 4 per cent stock = 0.04 of \$10,000 = \$400.
Proceeds of 4 per cent stock = $0.89\frac{1}{4}$ of \$10,000 = \$8925.
\$1 of 5 per cent stock costs \$1.05; therefore,
Amount of 5 per cent stock = \$8925 ÷ 1.05 = \$8500.
Income from 5 per cent stock = 0.05 of \$8500 = \$425.
Increase in income = \$425 − \$400 = \$25.

**8.** A room measures 16 feet by 21 feet, and is 11 feet high. There is one door 7 feet by 3 feet, and two windows 8 feet by 4 feet. Find the cost of papering it with paper 2 feet wide at 5 cents a yard.

Distance round the room = 16 + 16 + 21 + 21 = 74 ft.
Area of walls of room = 11 × 74 = 814 sq. ft.
Area of door and windows = 21 sq. ft. + 64 sq. ft. = 85 sq. ft.
Area to be papered = 814 sq. ft. − 85 sq. ft. = 729 sq. ft.
Area of one yard of paper = 3 × 2 = 6 sq. ft.
Number of yards required = 729 ÷ 6 = $121\frac{1}{2}$.
Cost of the paper = $121\frac{1}{2}$ × \$0.05 = \$6.07½.

*Ans.* \$6.07½.

A jar full of water weighs 1.325[kg]; filled with mercury it weighs 12.54[kg]. What is the capacity of the jar, and its weight? The specific gravity of the mercury is 13.59.

| | | |
|---|---|---|
| 12.540 | 13.59 | 0.890781 |
| 1.325 | 1 | 12.59 ) 11.215 |
| 11.215[kg] | 12.59[kg] | 10072 |
| | | 11430 |
| | | 11331 |
| | | 9990 |
| | | 8815 |
| | | 10670 |

Mercury in jar weighs 11.215[kg] more than water in jar.
A liter of mercury weighs 12.59[kg] more than a liter of water.
Capacity of jar $= \frac{11.215}{12.59}$ of a liter $= 0.890781$.
Weight of water in jar $= 0.890781$[kg].
Weight of jar $= 1.325$[kg] $- 0.890781$[kg] $= 0.434219$[kg] $= 434.22$[g].

*Ans.* 0.890781; 434.22[g].

**Extract the cube root of 5 to five places of decimals.**

| | |
|---|---|
| | 5.000(1.70997 |
| | 1 |
| $3 \times 10^2 = 300$ | 4 000 |
| $3(10 \times 7) = 210$ | |
| $7^2 = 49$ | |
| 559 | 3 913 |
| 259 | 87 000 000 |
| $3 \times 1700^2 = 8670000$ | |
| $3(1700 \times 9) = 45900$ | |
| $9^2 = 81$ | |
| 8715981 | 78 443 829 |
| 45981 | 8 556 171 0 |
| $3 \times 1709^2 = 8762043$ | 7 885 838 7 |
| | 670 332 30 |
| | 613 343 01 |
| | 1.70997 = *Ans.* |

For explanation of the method, see Wentworth and Hill's Practical Arithmetic, page 282.

# EXAMINATION MANUAL.

## *ARITHMETIC.*

### 1.

1. Write in words 15,006,021, and state how many times a number is increased by annexing three ciphers to it.
2. Multiply 2,035,674 by 3096.
3. Divide 275,487 by 736, and prove that the result is correct.
4. How many times is 195 yards 1 foot 8 inches contained in a mile?
5. Find the number of cubic inches in 1 cubic yard 24 cubic feet 760 cubic inches.
6. How many grains of gold in a cup weighing 8 ounces 4 pennyweights?

### 2.

1. How much must be added to sixty million four hundred six thousand two hundred ninety to make three hundred twenty million?
2. Multiply 456,978 by 789.
3. Divide three hundred thirty-seven million one hundred three thousand twenty-five by eight hundred sixty-one.
4. In 674,381 inches how many miles, rods, feet, and inches?
5. Find the difference between 30 years 8 months 3 weeks 6 days and 44 years 3 months 1 week 5 days.

## 3.

1. Write in words the sum of 4,300,702; 6,070,506; and 341,318.
2. Find the number which, subtracted from 80,000, leaves 57,735.
3. From the sum of eight million seventy-nine thousand six hundred ninety, and three hundred eighty-five thousand seven hundred nine, subtract their difference.
4. Divide 19,094,867 by 4009.
5. The circuit of a race-course is 137½ yards. How many times must a bicyclist go round to complete 5 miles?
6. Take 156 miles 160 rods 216 yards from 191 miles 80 rods 2 yards.

## 4.

1. Write in figures two million twenty thousand eighty-seven.
2. Express in words and in figures the excess of the value of one 5 over the other in the number 658,457.
3. Multiply seventeen thousand nine hundred forty-three by five thousand seventy-nine.
4. Divide five hundred one million five hundred by three thousand eight hundred fifty.
5. Reduce 125 square rods 23 square yards 6 square feet 108 square inches to square yards.
6. How many grains in a pound Avoirdupois? in a pound Troy?

## 5.

1. Write in figures ten million eighty-three thousand six hundred eighty.
2. Divide the product of 37,800 and 7950 by 630.
3. What number multiplied by 6702 will give 218,773,386?
4. How often is £1 17*s.* 6*d.* contained in £28 2*s.* 6*d.*?
5. An engine draws a train of 23 cars, each containing 5 long tons, 2123 pounds of coal. What is the weight of coal in the train?
6. A square drill-yard required 869 square slabs, each measuring 3 square feet 86 square inches. What is the area of the yard in square feet, etc.?
7. Required the weight of a guinea, if 45 can be coined from a pound of gold.

## 6.

1. A person walked 136 miles in 40 hours 48 minutes. How many minutes was he in walking a mile?
2. How many times must we take the number 7 to make 819?
3. By how much does the thirty-seventh part of three thousand six hundred sixty-three fall short of a hundred?
4. Reduce 7,896,432 grains Troy to pounds.
5. If 56 acres of land cost $700, what will be the value of 13 acres 80 square rods?
6. A man agreed to buy a haystack, paying $30 for each load. He found his wagon held 1 ton 392 pounds, and that the whole stack weighed 10 tons 1288 pounds. How much has he to pay?

## 7.

1. Find the circumference of a carriage wheel which revolves 1848 times in a journey of 3½ miles.

2. In 120,505 square feet how many acres, etc.?

3. If the moon moves forward in her orbit 57° 13′ 18″ in 13 days, find the distance she averages a day.

4. A man can buy a white hat, which lasts 4 months, for $0.75; he can buy a black hat, which lasts 9 months, for $1.75. Which is the cheaper? What is saved in 3 years by wearing the cheaper hat?

5. Find the number of pounds Troy equal to 78 pounds 4 ounces Avoirdupois.

6. Reduce 1 acre 91 square rods 2 square yards to square inches.

## 8.

1. Reduce 100,196,196 square inches to acres, etc.

2. Reduce 40 pounds 8 ounces 5 drams 1 scruple 7 grains to grains, Apothecaries' weight.

3. Find the cost of half an acre of ground at 63 cents per square yard.

4. The distance between two towns is 18 miles 40 rods 44 yards. How many telegraph poles will be required between them, the poles being 8 rods apart?

5. If $328 equal £74 2*s.* 10*d.*, by how many pence does a dollar exceed 4 shillings?

6. How many cubic yards, feet, and inches in 175,983 cubic inches?

## 9.

1. In 36,845,371 ounces Avoirdupois, how many long tons, cwts., etc.?
2. In 1,749,134 seconds how many weeks, days, etc.?
3. The latitude of St. Paul's in London is 51° 30′ 49″, and that of St. Peter's in Rome, 41° 53′ 54″. What is one-fifth of the difference of their latitudes?
4. Reduce 875,679 chains 25 links to miles, rods, etc.
5. Reduce 7658 square chains 625 square links to acres, square rods, etc.
6. Change 35 pounds 8 ounces 7 pennyweights 17 grains Troy to Avoirdupois weight.

## 10.

1. Express in figures nine thousand seventeen million fifty-nine thousand ninety-six.
2. How many days will 9867 pounds of hay last 13 horses, if each horse eats 33 pounds a day?
3. A boy has a bag containing 2360 chestnuts; he takes out 7 dozen for himself, and then divides the rest among 19 school-fellows, keeping those remaining over. How many chestnuts did he then have, and how many did each of the other boys have?
4. A city containing 758,043 inhabitants has 5 districts. The population of the first is 78,967; of the second, 139,753; of the third, 145,069; the other two districts have each an equal number of inhabitants. Find the population of each of these two districts.
5. Reduce 367 acres 155 square rods 25 square yards 8 square feet 74 square inches to square inches.
6. Reduce 1,186,126 inches to miles, etc.

## 11.

1. Reduce 2 miles 3 furlongs 20 rods 1 yard to inches.

2. What do 12 dozen chains weigh, if each contains 2 ounces 9 pennyweights 3 grains of metal?

3. Find the greatest common measure of 203 and 2291.

4. Find the least common multiple of 12, 21, 28, 30, 35.

5. Multiply $\frac{8}{11}$ of $1\frac{1}{8}$ by $5\frac{1}{3}$ of $\frac{1}{4}$.

6. Add together 0.0023, 2.36, 250, 0.527.

7. Reduce 3 quarts 1 pint to the decimal of a gallon.

## 12.

1. Reduce 1 furlong 15 rods 1 foot 6 inches to yards.

2. If a person spends $2226.50 a year, how much does he spend each day in an ordinary year?

3. Find the greatest common measure of 2163 and 504.

4. Find the least common multiple of 18, 16, 63, 24, 56.

5. Find the value of $2\frac{1}{5} \times 1\frac{5}{6}$ of $1\frac{2}{13} \times 3\frac{1}{4}$ of $1\frac{5}{11}$.

6. Subtract 2.03 from 20.2.

7. Find the value of 0.625 of a gallon.

## 13.

1. Reduce 357,000 inches to miles, furlongs, rods, etc.
2. At a festival 23,760 persons entered the enclosure between 10 A.M. and 4 P.M. What was the average per minute?
3. Find the greatest common measure of 5292 and 1520.
4. Find the least common multiple of 4, 9, 16, 28, 42.
5. Divide $5\frac{1}{4}$ by $\frac{3}{5}$.
6. If I sell $\frac{5}{8}$ of $\frac{4}{5}$ of an estate, what part of the estate have I left?
7. Multiply 3.26 by 1.02.

## 14.

1. A dozen persons hire an omnibus for $9.25. How much more must each pay than if the party were fifteen in number?
2. Find the greatest common measure of 3575 and 4719.
3. Find the least common multiple of 6, 15, 18, 35, 72.
4. Divide $20\frac{5}{14}$ by $17\frac{1}{12}$.
5. Find the value of $\frac{5}{8}$ of an acre.
6. Divide 998.824392 by 0.018.
7. Reduce 5 ounces 12 pennyweights 16 grains to the decimal of a pound.

## 15.

1. Find the greatest common measure of 5292 and 8316.

2. Find the least common multiple of 8, 12, 18, 24, 27.

3. Add together $\frac{2}{5}$, $\frac{1}{6}$, $\frac{7}{8}$.

4. Find the value of $\frac{33}{114}$ of a bushel.

5. Divide 2 weeks 3 days by $3\frac{3}{4}$.

6. Divide 160.68 by 3.9.

7. Reduce 3 quarters 3 pounds 2 ounces 2.816 drams to the decimal of a long ton.

## 16.

1. Find the greatest common measure of 731, 2329, and 3502.

2. Find the least common multiple of 3, 8, 17, 40, 153.

3. Add $\frac{2}{3}$, $\frac{5}{8}$, $\frac{7}{10}$, $\frac{8}{15}$.

4. Which is the greater $\frac{1}{3}$ of 4 or $\frac{1}{4}$ of 5, and by how much?

5. Find the value of $2\frac{2}{3}$ of 5 bushels + $1\frac{1}{8}$ of $2\frac{1}{2}$ pecks.

6. Divide 0.3964 by 0.75.

## 17.

1. Reduce $\frac{5}{8}$ of a pound Troy to the fraction of a pound Avoirdupois.

2. Divide 52 by 3.2.

3. Express 0.305 as a common fraction in its lowest terms.

4. Add together $2\frac{2}{3}$, $4\frac{1}{6}$, $3\frac{5}{12}$.

5. Find the greatest common measure and least common multiple of 125, 175, 225.

6. Divide $\frac{2}{3}$ of $\frac{1}{3}$ by $\frac{5}{7}$ of $\frac{3}{5}$.

## 18.

1. Which is the greater $\frac{2}{3}$ of $1\frac{1}{5}$ or $\frac{1}{7}$ of $5\frac{1}{4}$, and by how much?

2. Simplify $2\frac{1}{2} + \frac{3}{4}$ of $5\frac{1}{2} + 4\frac{7}{11} + 5$.

3. Add together $\frac{5}{6}$ and $2\frac{3}{5}$, and subtract their sum from 4.

4. Multiply 0.026 by 3.3; by 0.33; by 33; and by 0.033.

5. Divide 1.8 by 500.

6. Express 0.0075 as a common fraction in its lowest terms.

## 19.

1. Add together $3\frac{1}{2}$ of $1\frac{1}{5}$ and $2\frac{2}{5}$ of $1\frac{1}{6}$.

2. Subtract $\frac{2}{3}$ of $1\frac{1}{2}$ from $\frac{1}{2}$ of $2\frac{2}{3}$.

3. Reduce to a simple fraction $\dfrac{8\frac{3}{4}}{5\frac{5}{8}}$.

4. Divide 611 by 0.13.

5. Reduce 7.2 feet to the decimal of a rod.

6. Find the value of 0.065 of an acre.

7. Reduce $\frac{1848}{3003}$ to its lowest terms.

## 20.

1. Subtract $\frac{5}{6}$ from $\frac{6}{7}$; $\frac{6}{7}$ from $\frac{7}{8}$; and $\frac{7}{8}$ from $1\frac{1}{9}$; and add together the results.

2. Multiply 2 yards 1 foot $7\frac{4}{5}$ inches by $\frac{11}{18}$.

3. Reduce $\frac{8}{11}$ of a pint to the fraction of a gallon.

4. Divide 2175.68 by 100.

5. Reduce $\frac{106}{125}$ to its equivalent decimal fraction.

6. Reduce 15 square rods to the decimal of one-half an acre.

7. Find the value of 0.009943 of a mile.

## 21.

1. Find the value in English money of 1572.4185 francs, when the exchange is at 26.675 francs per pound.

2. Divide 101 by 1.01, and 0.101 by 10.1.

3. Reduce 14 hours 15 minutes to the fraction of $3\frac{1}{2}$ days.

4. Reduce to a simple fraction $\frac{10 \times \frac{1}{7}}{3 + \frac{2}{7}}$.

5. Find the greatest common measure and least common multiple of 144, 176, 272.

6. How many plots of $2\frac{1}{2}$ acres each can be made out of an estate one mile square?

## 22.

1. A man steps 2 feet 8 inches at each step. How many steps will he take in 2 miles?

2. Reduce to its lowest terms $\frac{3}{4}\frac{5}{7}\frac{7}{1}\frac{5}{5}$.

3. Subtract $121\frac{5}{6}$ from $202\frac{1}{2}$.

4. How can you determine that a number is divisible by 3 without actually dividing by 3?

5. Two pipes together fill a cistern in 1 hour, and one of them alone fills it in $1\frac{1}{2}$ hours. How long will it take the other alone to fill it?

6. Divide 3.52 by 2.2; by 0.22; and by 22.

## 23.

1. In 640,825 seconds how many weeks, days, etc.?

2. Reduce $\frac{8}{9}\frac{2}{2}\frac{6}{8}\frac{1}{7}\frac{5}{2}$ to its lowest terms.

3. Add $16\frac{11}{18}$, $1\frac{19}{36}$, $\frac{2}{3}$, $\frac{7}{24}$.

4. Subtract $3\frac{3}{4}$ from $30\frac{7}{19}$.

5. Find the product of $1\frac{7}{30} \times 3\frac{1}{25} \times \frac{11}{36} \times 11\frac{1}{81}$.

6. If $\frac{7}{12}$ of an estate be worth \$3003, what is the value of the estate?

7. Reduce 213 rods 1 yard 2 feet 6 inches to the common fraction of a mile.

## 24.

1. Divide 0.05625 by 0.0275.

2. Reduce £3 15*s.* 6.5*d.* to the decimal of £4.

3. Westminster Hall is 237 feet long by 68 feet wide; Brussels Town Hall, 264 feet by 50 feet. How many more persons could Westminster Hall accommodate than Brussels Town Hall, allowing $\frac{2}{3}$ of a square yard to each person?

4. Simplify $2\frac{5}{63} + \frac{1}{7} \times \frac{4}{9} - 2\frac{1}{8}$ of $(\frac{2}{3} \div \frac{7}{9})$.

5. Multiply $9 - 3\frac{6}{25}$ by $16\frac{2}{3}$ of $1\frac{1}{12}$.

6. Divide $5\frac{5}{18} - \frac{13}{36}$ by $1\frac{2}{7}$ of $8\frac{1}{6}$.

## 25.

1. Find the value of $\dfrac{2\frac{3}{4} \text{ of } 3\frac{2}{3}}{2\frac{5}{6}+\frac{1}{2}+\frac{1}{3}}$ multiplied by $\frac{2}{33}$ of 6.

2. Reduce to its lowest terms $\frac{19527}{23667}$.

3. A can do a piece of work in 10 days, B can do the work in 15 days. In what time can they both do it working together?

4. Arrange in order of magnitude $2.5 \times 0.075$; $2.625 \div 7$; $5 \times 0.05$.

5. Reduce 0.972 to its equivalent common fraction.

6. Reduce to a decimal $\frac{22}{1665}$.

7. Reduce 0.9 of a pound Avoirdupois to the decimal of 5 pounds Troy.

## 26.

1. How many cubic inches in a brick that is 9 inches long, 4 inches wide, 3 inches thick?

2. Reduce to a simple fraction $3\frac{1}{7} \times 3\frac{3}{10} \times 2\frac{3}{11} \times 2\frac{5}{22} \times \frac{2}{35}$.

3. What fraction of $\frac{1}{4}$ of a mile is $1\frac{1}{2}$ feet?

4. Reduce $6\frac{5}{6}$ of $365\frac{1}{4}$ days to the fraction of 3 years.

5. Express in figures seventy-three ten-thousandths.

6. Reduce 0.536 to a common fraction.

7. Divide 0.005868 by 0.036, and arrange the divisor, dividend, and quotient in order of magnitude.

8. Divide 0.5 by 25; 87.5 by 2.5; and 0.055757592 by 0.009207.

## 27.

1. Divide 10.8528 by 1.02 and express the quotient as a common fraction.

2. Reduce 2.5 gills to the decimal fraction of $3\frac{1}{2}$ gallons.

3. Find the value of 14.1275 acres.

4. What is the value of 40 acres 132 square rods at $37.50 per acre?

5. A railway train goes 200 miles in 8 hours. In what time will it make a journey of 40 miles?

6. How long will a journey of 15 miles 24 rods 3 yards take at the rate of 3 miles 204 rods 3 yards in 56 minutes?

## 28.

1. A race-horse goes 5 miles in 32 minutes. How long will he be in going 1650 yards?

2. Reduce $\frac{3}{5}$ of $\frac{5}{7}$ of a mile to the fraction of $\frac{5}{7}$ of $\frac{5}{8}$ of 3 miles.

3. Reduce $5.0\dot{1}\dot{8}$ to its equivalent common fraction.

4. Simplify $\dfrac{9\frac{1}{4} - 2\frac{7}{10}}{2\frac{3}{4} + 3\frac{4}{5}}$.

5. Express 2 feet 3 inches as the fraction of $4\frac{1}{2}$ yards.

6. Resolve 18, 16, 36, 44, 45, 48, 63, 121 into their simplest factors, and find their least common multiple.

## 29.

1. Sound travels at the rate of 1120 feet in a second. How far off is a thunder cloud, when the clap follows the flash of lightning in 10½ seconds?
2. The four sides of a field are 23 chains 19 links, 17 chains 34 links, 6 chains 85 links, 24 chains 62 links. How many yards around the field?
3. Reduce 10,000 square yards to acres, etc.
4. Find the sum of 8 cubic yards 13 cubic feet 1234 cubic inches, 5 cubic yards 14 cubic feet 976 cubic inches, 2 cubic yards 5 cubic feet 854 cubic inches, and 7 cubic yards 10 cubic feet 1012 cubic inches.
5. Express 1 peck 6 quarts 1 pint as the fraction of 6 bushels 1 peck 3 quarts.
6. Express 13 hours 15 minutes 17 seconds as the fraction of 6 days 1 hour 48 minutes 7 seconds.
7. Find the value of $\frac{3}{11}$ of 3 long tons 5 cwt. 101 pounds.

## 30.

1. There are 7 miles of road in a certain district. If the average width of the road is half a chain, how many acres of land consist of roads?
2. Reduce 1012 quarts to bushels.
3. Reduce 673,856 seconds to days.
4. A dishonest milkman mixes a pint of water with every two quarts of milk. How many gallons will he make in this way out of 20 gallons of pure milk?
5. A well is 18 yards 2 inches deep, and the wheel is 4 feet 2 inches round. How many turns of the wheel will raise the bucket?
6. Express 1 day 1 hour 50 minutes 42 seconds as a decimal of a day.
7. Express in days, hours, etc., the true length of a year, 365.242218 days.

## 31.

1. Find the least common multiple of 8, 10, 12, 25, 30, 36.

2. Add $\frac{5}{6}$ of a score to $\frac{4}{5}$ of a dozen, and subtract from the result $\frac{3}{8}$ of a hundred. What is the remainder?

3. A cistern can be filled in 20 minutes by one pipe and in 30 minutes by another. In how many minutes will it be filled by both together?

4. Express $1\frac{3}{5}$ of 7 yards 2 feet 9 inches as a fraction of 13 yards 7 inches.

5. A man walked $11\frac{3}{4}$ miles in $3\frac{1}{2}$ hours. How long would he be in going 20 miles at the same rate?

6. Divide 723.6 by 22.5; and 7.236 by 0.0225.

7. Find the value of $3.\dot{5} \times 0.8$.

## 32.

1. Find the value of $0.\dot{3} \times 0.\dot{2}\dot{7}$.

2. If $\frac{3}{5}$ of a ton of coal costs \$4, what will $1\frac{1}{4}$ cwt. cost?

3. Find the value of 0.2625 of a mile.

4. The highest mountain in the world is Dhawalaghiri, in the Himalayas, and is 28,000 feet above the level of the sea. Express this as a decimal of the earth's radius, 4000 miles.

5. From 1 pound Troy of standard gold are coined 46.725 sovereigns. Find the weight in grains of each sovereign.

6. The depth of a canal is 6 feet 4 inches, the width 19 feet 8 inches, and the length 20 miles. How many cubic feet of water will it hold?

## 33.

1. Add together $\frac{1}{10}$, $\frac{7}{25}$, $\frac{8}{15}$, and $\frac{2}{5}$.
2. Divide $\frac{7}{18}$ by $6\frac{2}{9}$.
3. Reduce 789,654,328 inches to miles.
4. Reduce £25 16*s.* 8*d.* to the fraction of £15 10*s.*
5. The upper floor of a house is 18 feet 4 inches above the ground and is reached by two equal staircases, separated by the landing of the first floor. How many stairs are there in each staircase, if each stair is 11 inches high?
6. How many hurdles will it take each $5\frac{1}{2}$ feet long to make a square sheep-fold, each side of which is 40 rods?
7. If a quantity of wheat fills 1155 sacks, each holding 8 bushels 4 quarts, how many sacks will it take to contain the wheat when each sack holds 6 bushels 3 quarts?

## 34.

1. If 64 gallons of wine and 16 gallons of water are mixed, how much wine is there in 2 quarts 1 pint of the mixture?
2. Find the total weight of 5792 iron bars, each weighing 23 pounds 10 ounces.
3. Reduce 0.056 of a square rod to the decimal of an acre.
4. Find the value of 0.58 of a common year.
5. The price of gold being £3 17*s.* $10\frac{1}{2}$*d.* an ounce, find the weight of a nugget worth £341.0925.
6. Find the greatest common measure and least common multiple of 161, 253, 299.
7. Simplify $1\frac{1}{8}\frac{3}{2} + \frac{3}{5}$ of $\frac{10}{9} - \frac{11}{15}$ of $6\frac{1}{4}$.

## 35.

1. Add 0.60457; 46.70056; 5.80007; and 4.7896.

2. Divide 5.0666 by 21.56.

3. Reduce 2.025 miles to yards.

4. Find the difference between 0.44 of 1 week and 0.125 of 8 days.

5. If the weight of 1 cubic foot of water is $62\frac{6}{10}$ pounds, find the error in calculating the weight of 1000 cubic feet, on the assumption that 1 cubic foot weighs 1000 ounces.

6. Supposing the quick-step in marching to be 2 paces per second, and the length of each pace to be 28 inches, find the time in which a regiment will march 35 miles.

7. Simplify $1\frac{1}{3} - (1\frac{1}{3}$ of $\frac{1}{2})$.

## 36.

1. Reduce 186 yards 2 feet 8.04 inches to the decimal of a chain (22 yards).

2. Add together $\frac{5}{32}$ of a square mile, $\frac{7}{10}$ of an acre, and $\frac{5}{8}$ of a rood, giving the result in acres, roods, and square rods.

3. Simplify $\frac{1}{3} + 6\frac{1}{2} \times \frac{3\frac{4}{5}}{7} - \frac{1}{3} \times \frac{2}{5}$.

4. Reduce 3 cwt. 14 pounds to the decimal of a long ton.

5. Find the rent of 215 acres 45 square rods at $5.62 an acre.

6. If $4\frac{5}{9}$ ounces Avoirdupois cost $\$8\frac{3}{32}$, what will $8\frac{13}{24}$ pounds cost?

## 37.

1. If a bankrupt has assets to the amount of $1020, and debts to the amount of $3225, how many cents on a dollar will his creditors receive?
2. Two farmers bought a crop of hay. One took $\frac{5}{8}$ of it, and paid $12. What had the other to pay?
3. In a town of 450 people, 0.44 were men and boys, 0.38 were women and girls, and the rest were children. How many were there of each?
4. If the carriage of $12\frac{1}{4}$ cwt. for 50 miles cost $\$3\frac{9}{24}$, what will it cost to carry $17\frac{1}{2}$ cwt. the same distance?
5. Simplify $(2\frac{1}{2}+\frac{1}{8})\div(2\frac{2}{3}-\frac{1}{8})$.
6. If $\frac{5}{6}$ of a yard cost $\frac{2}{3}$ of $1, what will $\frac{11}{12}$ yards cost?
7. Divide 7.584057 by 11.7.

## 38.

1. In 4,076,412 dwts. Troy, how many pounds, ounces, etc.?
2. Divide $100\frac{5}{8}$ by 35.
3. Divide 18,454.9239 by 0.1225.
4. In 17,630,754 square inches, how many acres, etc.?
5. Subtract $8\frac{8}{13}$ from $12\frac{9}{117}$.
6. Subtract 6.04083 from 12.7.
7. A person sold $\frac{2}{3}$ of his estate, bequeaths $\frac{3}{4}$ of the remainder to his son, and leaves the rest to be distributed equally among 3 charities. If each of these charities receives $136.25, what is the value of the estate?

## 39.

1. Find the value of $\frac{2}{3}\frac{9}{3}$ of a mile.

2. Reduce 2 weeks 2 days $19\frac{1}{3}$ hours to the fraction of a month (4 weeks).

3. Reduce $\frac{5}{1}\frac{9}{8}\frac{0}{0}$ to a decimal.

4. A bankrupt's liabilities are £3768 17 *s.* 6 *d.* What are his assets, if he can pay 13 *s.* $7\frac{1}{2}$ *d.* in the pound?

5. Subtract $\frac{5}{1}\frac{}{2}$ dwt. from 2.6 ounces, and give the answer as the decimal of a pound Troy.

6. Divide 218.4 by 0.168.

7. Divide 12 by $6\frac{3}{4}\frac{}{0}$.

## 40.

1. Express 13 minutes $7\frac{1}{2}$ seconds as the decimal of 1 hour.

2. Add 6, $1\frac{1}{4}$, $\frac{7}{1}\frac{}{6}$, and $\frac{1}{1}\frac{1}{2}$.

3. Find the cost of 11 miles 120 rods 165 feet of railway at $32,500 per mile.

4. Add 2.6 days and 0.85 of an hour, and give the answer in minutes.

5. In 156,704 square inches, how many square yards, etc.?

6. Divide 8.4605 by 0.248 to three places of decimals.

7. Subtract $6\frac{4}{5}$ from $8\frac{3}{7}$.

## 41.

1. In 57,625,318 square inches, how many acres, square rods, etc.?

2. A bankrupt's estate amounts to £910 3*s.* 1½ *d.*, and his debts to £875. How much can he pay in the pound?

3. What is the circumference of a wheel which makes 514 revolutions in passing over 1 mile 467 yards 1 foot?

4. Find the value of $5\frac{3}{4} - 4\frac{1}{7} + \frac{5}{28} - 1\frac{1}{2}$.

5. From $2\frac{1}{4} \div 3\frac{1}{8}$ take $\frac{1}{3} \times \frac{2}{5} \times \frac{5}{7} \times \frac{3}{8}$.

6. Divide 18.13 by 0.00037.

## 42.

1. A piece of cloth, when measured with a yard measure that is $\frac{2}{3}$ of an inch short, appears to be $10\frac{1}{2}$ yards long. What is its true length?

2. Divide 120,987.2 by 400.

3. Add $\frac{14}{17}$, $3\frac{1}{9}$, $1\frac{5}{51}$, and $\frac{6}{27}$.

4. Simplify $\dfrac{(4\frac{1}{2} + 7\frac{1}{2}) \div 3\frac{1}{2}}{\frac{1}{7} \times 2\frac{2}{7} \times 5\frac{1}{4}}$.

5. The weight of a cubic inch of water is 253.17 grains; that of a cubic inch of air 0.31 grains. Find to three places of decimals how many cubic inches of water are equal in weight to 1 cubic foot of air.

6. Find the price of 5 acres 72 square rods of land at $47.50 per acre.

## 43.

1. Reduce 42 rods 1 yard 8 inches to the fraction of a mile.
2. Find the value of 1.46875 acres.
3. Divide the product of 6.225 and 8.25 by 0.0025.
4. What fraction multiplied by $\frac{3}{5}$ will give $\frac{5}{6}$? what fraction divided by $\frac{3}{5}$ will give $\frac{5}{6}$? what fraction subtracted from $\frac{13}{6}$ will give $\frac{7}{29}$?
5. Arrange in order of magnitude $\frac{21}{122}$, $\frac{20}{121}$, $\frac{22}{123}$.
6. A and B start at a distance of 64 miles from each other. A walks $3\frac{1}{2}$ miles an hour; B, $2\frac{1}{2}$. If they start at the same time, how many miles will they each walk before they meet?
7. A ship left England at noon, January 1, 1851. She reached a port in Australia at midnight (Greenwich time), April 23. If the length of the voyage was 18,225 miles, what was her average rate per hour?

## 44.

1. Subtract 17.2398 from 27.06.
2. Multiply 46.2375 by 0.0074.
3. Divide 92.3784 by 0.623 to three places of decimals.
4. Find the product of $\frac{9}{14}$, $\frac{5}{27}$, $9\frac{4}{5}$, and $2\frac{2}{7}$.
5. Subtract 4.42 of an hour from 3.64 of a day.
6. Reduce 136,240 square feet to acres, etc.
7. Reduce 234,567 grains to pounds, ounces, etc., Apothecaries' weight.

## 45.

1. The imperial gallon contains 277.274 cubic inches. What is the size of a pint pot in cubic inches? What weight of water will it hold, if a cubic foot of water weighs 1000 ounces?
2. What number added to the sum of $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, and $\frac{5}{6}$ will make 4?
3. A field of $3\frac{1}{2}$ acres is divided into 28 equal parts. What fraction of an acre is there in each part?
4. Find the sum of 17.01, 0.1303, 500.42101, 0.001, and 6.6.
5. Divide 6.2301533682 by 8.8964.
6. If 7 tons 336 pounds of coal cost $32.50, what will 1232 pounds cost?

## 46.

1. Find the wages of a man for 3 weeks 4 days 8 hours at $8 per week, reckoning 6 days to a week and 10 hours to a day.
2. Reduce 30 rods 2 yards 1 foot to the fraction of 150 rods 4 yards 2 feet 1 inch.
3. If $\frac{5}{7}$ of an estate is worth $870, what is the value of $\frac{2}{17}$ of it?
4. Express in the simplest form $3\frac{1}{2} + \frac{7}{8}$ of $10\frac{3}{4} + \frac{3\frac{1}{6}}{1\frac{3}{18}}$.
5. What number multiplied by $\frac{4}{5}$ will produce $90\frac{1}{3}$?
6. What number added to $1\frac{7}{10} + 3\frac{9}{16} + 2\frac{1}{20} + \frac{5}{24}$ will make the sum total 10?
7. Give in feet the value of 7.0125 miles.

## 47.

1. Given the fractions $\frac{8}{88}$, $\frac{89}{161}$, and $\frac{47}{194}$; express the difference of the first two as a fraction of the difference of the last two.

2. Reduce $\frac{1882}{1986}$ to its lowest terms.

3. Divide 16.9 by 0.0013, and also by 1.3.

4. Reduce $0.5\dot{3}$ and $0.009\dot{8}\dot{7}$ to equivalent common fractions.

5. Find the value of 0.3925 of 2 years, each year containing $365\frac{1}{4}$ days.

6. Reduce 6 yards 2 feet 7.5 inches to the decimal of a mile.

## 48.

1. What decimal of 1 day is 23 hours 15 minutes 6 seconds?

2. Find the average of $21\frac{2}{3}$, $73\frac{4}{5}$, 0, $3\frac{13}{200}$, 82, $17\frac{3}{20}$, $5\frac{1}{4}$, $9\frac{5}{12}$.

3. Add $\frac{7}{16}$ of £5, $\frac{2}{7}$ of £9 13 *s.* $2\frac{3}{4}$ *d.*, and $\frac{5}{12}$ of 2*s.* 6*d.*

4. A and B can do a piece of work in 7 days, B and C can do the work in 8 days, and all three together can do it in 5 days. What part of the whole work can each do in 1 day?

5. What will be the cost, at 18 cents a square yard, of painting the walls of a room 17 feet 3 inches long, 15 feet 5 inches wide, and 13 feet 6 inches high, allowing 54 square feet for windows, etc.?

6. Find what fraction the sum of $\frac{1}{24}$, $\frac{1}{56}$, $\frac{1}{21}$, and $\frac{1}{12}$ is of $2\frac{2}{7}$ of $1\frac{1}{6}$ of $\frac{8}{9}$.

## 49.

1. A person possessing $\frac{3}{14}$ of an estate sold $\frac{2}{7}$ of $\frac{5}{16}$ of his share for $\$120.62\frac{1}{2}$. What would $\frac{1}{5}$ of $\frac{3}{16}$ of the whole estate sell for at the same rate?

2. Express as a fraction of $\$5$ the difference between $\$7\frac{4}{5}$ and $\frac{4}{5}$ of $\$7$.

3. Subtract 2.63 dwts. from 12.13 ounces Troy, and express the answer in pennyweights.

4. In 76,128,976 inches how many miles, etc.?

5. Divide 78 by 361.059 to three places of decimals.

6. Find the value of $2.5 + \frac{1.5}{0.02} - 6.002$.

## 50.

1. Find the average of $12\frac{2}{25}$, 21, $7\frac{3}{4}$, 0.034, 3.125, 0, 24.5, and $12\frac{7}{20}$. Express the fractional part decimally.

2. Reduce to the simplest form $\frac{435.1 \times 0.0046}{0.125}$.

3. Divide the sum of 14.4 and 1.44 by their difference, and express the result as a common fraction.

4. A can build a wall in $3\frac{1}{2}$ days, and B in $5\frac{1}{2}$ days. In what time will A and B together do it?

5. A brick 9 inches long, $4\frac{1}{2}$ inches broad, and 3 inches thick weighs 9 pounds nearly. What would a brick weigh if it were 12 inches long, 6 inches broad, and $4\frac{1}{2}$ inches thick?

6. Subtract 73.4698 from 108.30125.

## 51.

1. Add $\frac{1}{6}$, $2\frac{1}{7}$, and $13\frac{8}{10}$; divide this sum by $13\frac{1}{14}$; and subtract the result from $5\frac{8}{70}$.
2. A cistern can be filled in 50 minutes by one pipe, and in 1 hour 5 minutes by another. In how many minutes will it be filled, if both are open together?
3. If a 4 per cent stock is at $82\frac{1}{8}$, what will be the cost of $1000 stock, and what sum will be gained by selling out at $86\frac{1}{4}$?
4. An army is besieging a town in which are 1000 men, with provisions for three months. How many must leave at once, in order that the rest may be able to subsist a year?
5. Divide 7.619 by 0.0019.
6. Arrange in order of magnitude $\frac{7}{15}$, $\frac{9}{17}$, $\frac{13}{25}$, $\frac{11}{21}$.

## 52.

1. A room is 20 feet 6 inches long, 15 feet 6 inches wide, and 16 feet high. It has two doors, each 8 feet by 3 feet 9 inches; it has one window 5 feet by 7 feet, and two windows, each 5 feet by 4 feet. What will it cost to paper the room with paper 1 yard wide, at 20 cents per yard?
2. Divide 0.101 by 0.5; by 0.05; by 50; and by 5000.
3. Reduce to a common fraction $0.01\dot{0}3\dot{4}$.
4. Divide $\frac{9}{11}$ of $\frac{19}{81}$ by $\frac{33}{153}$ of $\frac{114}{121}$.
5. Find the square root of 488,601.
6. Find the simple interest of $1025 for 13 years at $4\frac{1}{2}$ per cent.

## 53.

1. If $\frac{3}{8}$ of a yard of cloth cost $\frac{2}{5}$ of a dollar, what will $\frac{5}{16}$ of a yard cost?
2. Find the greatest common measure of 2526 and 2947.
3. Subtract 0.002 from 11, and multiply 0.01 by 1.01.
4. Divide $2\frac{2}{7}$ of $1\frac{2}{5}$ by $3\frac{1}{3}$ of $\frac{3}{5}$ of $\frac{1}{4}$.
5. If 0.5 of £1 buys 0.4 of a gallon, how much may be bought for 6 *s.* 3 *d.*?
6. A steam engine and a horse start together. The engine does the first mile in 5 minutes, the horse in 4 minutes. After this mile the rate of the engine is 30 miles per hour, that of the horse 20 miles per hour. Which wins in a three-mile race, and by how much?

## 54.

1. Divide 1.44 by 1.2; by 12; by 0.012; and by 120.
2. Find the square root of 449.44.
3. What is the cost of carpeting a room 21 feet by 30 feet with carpet half a yard wide, running across the room, at 75 cents a yard?
4. Divide $1300 into three parts, in the ratio of 6, 4, 3.
5. If 12 men do a piece of work in 15 days of 12 hours each, how many days of 9 hours will 10 men take to do it?
6. Find the income produced by investing $4500 in 3 per cent bonds at 90; and that produced by investing $2850 in $3\frac{1}{2}$ per cent bonds at 95.

## 55.

1. Reduce 12 *s.* 6 *d.* to the decimal of a pound sterling.

2. Divide $\frac{1}{4}$ of $\frac{1}{5}$ of $4\frac{2}{7}$ of $2\frac{1}{8}$ by $\frac{1}{6}$ of $4\frac{1}{5}$ of $3\frac{3}{4}$ of $1\frac{1}{7}$.

3. Find the compound interest on $100 for two years at 10 per cent.

4. If 24 men do a piece of work in 14 days of 9 hours, how many men will do it in 12 days of 7 hours.

5. Find the least common multiple of 10, 14, 15, 21, 30, 42.

6. What sum invested in 3 per cent bonds at 92 will produce an income of $100 per annum?

7. The gross receipts of a railway company are $231,100. After deducting 35 per cent for working expenses, and paying 6 per cent interest on $2,500,000 bonds, what sum is left for dividing among the shareholders?

## 56.

1. Express as a decimal fraction the sum of $\frac{1}{2}$, $\frac{3}{4}$, $\frac{5}{6}$, $\frac{7}{8}$, $\frac{9}{10}$, $\frac{11}{12}$.

2. Simplify $\dfrac{1}{2+\dfrac{3}{4+\frac{5}{6}}}$; and $\dfrac{\frac{2}{3}\times\frac{3}{8}\div 2}{\frac{1}{6}\left(\frac{4}{5}-\frac{1}{16}\right)}$.

3. Divide 36.33 by 210; 35 by 0.05; 0.002 by 200.

4. Find the square root of 22.1841.

5. If 3 pounds of tea at $1.56 per pound, 5 pounds at $1.20, and 7 pounds at $.60 are mixed, at what price per pound must the mixture be sold to gain $2\frac{1}{2}$ per cent?

6. Find the interest of $535 for 9 months at $4\frac{1}{2}$ per cent.

## 57.

1. Find the greatest common measure of 124,321 and 197,451.

2. Reduce 0.075 of a pound sterling to the common fraction of 4 *s.* 6 *d.*; and 2 square rods 9 square yards 4 square feet 72 square inches to the common fraction of 1 acre 60 square yards.

3. A man buys eggs at 11 cents per dozen, and sells them at 2 cents apiece. What does he gain per cent?

4. What sum, if put out at 3½ per cent for 6 years, will produce $28.87½, simple interest?

5. Divide 1.69 by 0.13; 12.1 by 0.011; 0.001 by 0.01.

6. Find the square root of 4.1209.

## 58.

1. Find the simple interest on $387.50 for 5 years 3 months at 3½ per cent.

2. Find the least common multiple of 3, 5, 7, 9, 15, 63.

3. Divide $1-(\frac{1}{2}+\frac{1}{8}+\frac{1}{24})$ by $1-\frac{1}{2}$ of $\frac{1}{8}$ of $\frac{1}{24}$.

4. Multiply 0.000725 by 31.25; and divide the product successively by 6.25, 625, and 0.0625.

5. At what price per hundredweight must goods be sold, which were bought at $5 per ton, in order to gain 6 per cent?

6. A manufacturer makes a profit of 20 per cent, wholesale dealer 25 per cent, shopkeeper 40 per cent. What is the first cost of an article bought at a shop for $4.20?

## 59.

1. Divide $154 among 4 persons in the proportion of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$.

2. In how many days of 12 hours will 72 men do a piece of work which 60 men can do in 30 days of 9 hours?

3. Find the interest on $354.27 for 3 years 2 months 12 days at $2\frac{1}{2}$ per cent.

4. $4500 is divided among A, B, C, and D. A receives $\frac{1}{2}$ of the money, B and C each $\frac{2}{5}$ of the remainder. How much is left for D?

5. Express as common fractions 0.001375; $0.\dot{0}\dot{3}$; $7.193\dot{1}\dot{8}$.

6. A can walk 10 miles in $2\frac{1}{4}$ hours, and B can walk 11 miles in $2\frac{1}{2}$ hours. They start to walk a match of 55 miles. Which will win, and by how much time?

## 60.

1. The profit made by selling beer at 1*d.* per pint above cost is 50 per cent. What is the gain per cent by selling it at 6*d.* per gallon above cost?

2. Find the compound interest on $66.67 for 2 years at 9 per cent.

3. How much money must be invested in 3 per cent bonds at 92 to secure an annual income of $150?

4. Find the L.C.M. of 12, 84, 120, 132, 156.

5. Reduce $\frac{1805}{5985}$ to lowest terms.

6. A piece of work can be done in 50 days by 35 men. After 12 days 16 men strike. How soon will the rest finish the work?

## 61.

1. Find the greatest common measure of 5522 and 6006.

2. Divide $\frac{1}{12} - \frac{1}{15}$ by $3\frac{1}{7} - 2\frac{3}{4}\frac{1}{5}$.

3. Express as common fractions 0.06125 and 0.1237.

4. If a room is 27 feet 5 inches long, 14 feet 7 inches wide, 12 feet 10 inches high, how much paper $\frac{7}{8}$ of a yard wide is required to cover the walls?

5. What is the amount at simple interest of $1275 in 5 years 8 months at $3\frac{1}{2}$ per cent?

6. If I buy sugar at $7 per cwt., at what rate per pound must I retail it to gain $7\frac{1}{7}$ per cent?

## 62.

1. If 8 men can reap 40 acres of wheat in 7 days, how many acres will 24 men reap in 28 days?

2. Find the square root of 2,900,209.

3. How many cubic feet of air in a room 10 feet long, 8 feet 6 inches broad, and 6 feet 6 inches high?

4. A $4\frac{3}{4}$ per cent stock can be purchased at 91. What per cent interest will this investment yield?

5. When the Centigrade thermometer marks 25 degrees, what will Fahrenheit's thermometer mark?

6. Find the greatest common measure of 210; 258; 903.

## 63.

1. Simplify $\dfrac{1}{3+\dfrac{3}{4\frac{1}{2}}}$ and $\dfrac{2\frac{1}{4}-1\frac{2}{5}}{8.5+1.9}$.

2. Express as decimals $\frac{1}{25}$, $\frac{3}{125}$, and $\dfrac{15s.\ 9\frac{3}{4}d.}{£1}$.

3. How many miles will a ploughman walk, in ploughing an acre of ground, if each furrow is a foot in breadth?

4. A room is $12\frac{1}{2}$ feet by 10 feet, and 7 feet high. How many yards of paper 2 feet 6 inches wide will it take to paper the room, if the waste is ten per cent?

5. A plank is 3 inches thick, 18 inches wide, and 30 feet long. How many board feet does it contain?

6. Eggs are sold at the rate of 5 for 4 cents. At what price were they bought if the profit was 20 per cent?

## 64.

1. Find the square root of 0.00027 to four places of decimals.

2. If I sell \$2500 3 per cent stock at 95, and invest the proceeds in $4\frac{1}{2}$ per cent stock at par, what difference does it make in my income?

3. What is the cost of papering a room 16 feet long, 12 feet wide, $10\frac{1}{2}$ feet high, with paper 21 inches wide at 7 cents per yard, if the waste is $12\frac{1}{2}$ per cent?

4. Express $\frac{7}{256}$ as a decimal; and 0.1236 as a common fraction.

5. Divide 22.4615 by 0.167; and 0.004095 by 0.273.

6. Find the least common multiple of 3, 8, 15, 21, 18.

## 65.

1. A owns $\frac{1}{3}$ of a vessel, B $\frac{1}{4}$, and C $\frac{1}{5}$, and the rest belongs to the master. What is the master's share?
2. If two acres will maintain 3 horses for 4 days, how long will 6 acres maintain 6 horses?
3. Divide 9.3828 by 1117; by 11.17; by 0.01117.
4. What is the difference between the simple and compound interest on $550 for 3 years at 5 per cent?
5. A merchant sold goods for $750 more than he paid for them, and cleared 15 per cent. What did he pay for them?
6. Two boats row a race of 1 mile 720 yards. One rows 31 strokes a minute, and clears 30 feet each stroke; the other rows 33 strokes, and clears 28 feet. How many yards ahead will the winning boat be when it passes the winning post?

## 66.

1. What is the price of a Turkey carpet 20 feet 6 inches long by 12 feet 9 inches wide, at $5.04 a square yard?
2. If I invest $3570 in 7 per cent stock at 2 premium, what income do I derive from it?
3. A grocer bought 40 pounds of tea at 60 cents, and 90 pounds of coffee at 42 cents a pound. He sold the tea at 96 cents and the coffee at 36 cents a pound. What did he gain or lose?
4. Find the least common multiple of 34, 51, 85, 120, 170.
5. Simplify $\frac{12.4 + 0.064 - 0.066}{0.002}$.
6. Add $\frac{1}{4}$ of $\frac{3}{5}$ of 5*s.* 4*d.*, $\frac{2}{3}$ of $\frac{5}{7}$ of 6*s.*, $\frac{3}{7}$ of $\frac{2}{5}$ of 2*s.*

## 67.

1. Find the cost of papering a room 21 feet long, $16\frac{1}{2}$ feet wide, $10\frac{1}{4}$ feet high, at 15 cents per square yard.

2. A can run 10 yards to B's 9. How many yards start must A give B in a mile to make an even race?

3. Simplify $\dfrac{1-\frac{1}{5}\left(\frac{1}{2}+\frac{1}{7}\right)}{1-\dfrac{1}{2-\frac{1}{4}}}$.

4. If I sell out \$10,000 of $3\frac{1}{2}$ per cent stock at $94\frac{1}{2}$, and buy with the proceeds 6 per cent stock at 105, what will be the alteration in my income?

5. Find the true discount on \$1025.62$\frac{1}{2}$ for 6 months at $5\frac{1}{8}$ per cent per annum.

6. Reduce to its lowest terms $\frac{8}{4}\frac{5}{4}\frac{9}{6}\frac{7}{1}\frac{7}{2}\frac{5}{1}$.

## 68.

1. Find the L.C.M. of 2, 3, 4, 5, 8, 12, 72, 84.

2. Simplify $\dfrac{2\frac{1}{16}\frac{3}{}\times\frac{1}{3}}{\frac{3}{5}\text{ of }\frac{5}{18}\div 5\frac{1}{6}}\div\frac{1}{5}$ of $1\frac{5}{16}$.

3. Find the cost of paving a passage 15 yards 2 feet 6 inches long, and 3 yards 6 inches wide, with tiles costing \$3.60 per square yard.

4. Add together $53\frac{1}{2}$, 36.875, $4\frac{5}{8}$, $\frac{3}{4}$ of $7\frac{1}{2}$, and divide the result by 0.01.

5. If 6 men can dig 5 acres in 8 days of 10 hours, in how many days of 12 hours can 4 men dig 6 acres?

6. At what rate of interest will \$2560 amount to \$3328 in 5 years?

## 69.

1. If I sell out $1000 from 3 per cent stock at 88, and buy 5 per cent stock at 110, what alteration do I make in my income?

2. If a man buys 560 tons of coal at 14*s.* 8*d.* per ton, and sells it at 11*d.* per cwt., what is his gain per cent?

3. Divide 42.5 by 0.017; and find the value of 0.625 of 3 pounds Avoirdupois.

4. Simplify $3-(\frac{1}{2}+\frac{1}{3})-(\frac{1}{5}+\frac{1}{6})$.

5. Find the square root of 1.00060009.

6. The gross yearly rental of an estate is $2100; taxes and repairs amount to 25 per cent of the rental. The owner sells the estate for 21 times the gross yearly rental, and invests the proceeds in 3½ per cent stock at 98. What does he gain or lose in his net income?

## 70.

1. If $1350 at simple interest amount to $1570.50 in 1 year 8 months, find the rate per cent.

2. If by selling wine at $3 a gallon I lose 6 per cent, at what price must I sell it to gain 17½ per cent?

3. Find the compound interest on $750 for 5 years at 2½ per cent.

4. Reduce 347,894,178 square inches to acres, etc.

5. If $850 amounts to $913.75 at 2½ per cent, find the time.

6. A room is 10 feet high, 5½ yards long, and 3 yards wide. It contains a door 8 feet by 4 feet, two windows each 5 feet by 4 feet, and a fireplace 6 feet by 4 feet 6 inches. How many square yards on its walls require to be painted?

## 71.

1. The distance between the posts of a railway telegraph is 60 yards. Find the rate of a train which passes 11 posts in 50 seconds.

2. Find the income from an investment of $5308.33 in 3 per cent bonds at 91.

3. A invests $1200, B $2400, in business. The net profit at the end of the year is $720. How much should A and B each receive, and what is the rate of interest upon the investment?

4. Find the least common multiple of 5, 7, 16, 28, 48, 21.

5. If $\frac{1}{8}$ of a ship be worth $292.25, what part of her will be worth $1002?

6. If 10 men can reap 20 acres in 4 days, how many men can reap 70 acres in 10 days?

## 72.

1. What sum of money will amount to $276.25 in 1 year and 3 months at 5 per cent simple interest?

2. When 3 per cent bonds are at 75, what sum must be invested to produce an annual income of $120?

3. Find the present worth of $1836, due 4 years hence, at 5 per cent simple interest.

4. What is the rent of a field containing 112 acres 109.5 square rods at $2.64 an acre?

5. Divide 1368.2394 by 2400.21, and by 0.00240021.

6. Simplify $\frac{1\frac{7}{9} \text{ of } \frac{27}{64}}{\frac{11}{12} \text{ of } 9\frac{9}{11}} \div \frac{44\frac{4}{7} \text{ of } \frac{21}{160}}{\frac{25}{6} \text{ of } \frac{15}{34}}$.

## 73.

1. Find the value of £2 + $\frac{1}{5}$ of £140 10*s.* 6*d.* + $\frac{2}{5}$ of £1 1*s.*

2. Find the greatest common measure of 1288, 1736, 104.

3. If 120 men build a house 60 feet high in 15 days, how many will build a house 55 feet high in 10 days?

4. Find the difference between the simple and compound interest on $955 at 6 per cent for 4 years.

5. A garrison of 1000 men have provisions for 30 days. At the end of 10 days a reinforcement arrives, and then the provisions last only 5 days. What is the number of the reinforcement?

6. Simplify $\frac{(2+\frac{1}{5})\div(3+\frac{1}{7})}{(\frac{1}{2}-\frac{1}{3})\times(4-3\frac{3}{7})}$

## 74.

1. Express 0.466 as a common fraction.

2. A sum of money was borrowed at 5 per cent simple interest. In 7 years it amounted to $810. What was the sum borrowed?

3. If 100 men in 6 days of 10 hours can dig a trench 200 yards long, 3 yards wide, and 2 yards deep, in how many days of 8 hours can 180 men dig a trench 360 yards long, 4 yards wide, and 3 yards deep?

4. Find the cube root of 42,508,549.

5. How many rods of fencing are required to enclose a square park containing 832 acres 105 square rods?

6. Which is the better investment, 4 per cent stock at 120, or 2½ per cent stock at 75?

## 75.

1. What is the length of the edge of a cubical cistern which contains as much as a rectangular one whose edges are 154 feet 11 inches, 70 feet 7 inches, and 53 feet 1 inch?

2. For what must I sell a horse that cost me $75.50 so as to gain 5½ per cent?

3. By selling 12 pounds of tea for $7.56, I gain 5 per cent. What do I gain or lose per cent by selling 50 pounds of the same tea for $31?

4. Find the amount of $4250 for 2 years 6 months at 5 per cent compound interest.

5. Reduce $\frac{8}{9}\frac{5}{3}\frac{6}{6}$ and $\frac{1}{3}\frac{8}{0}\frac{5}{0}\frac{9}{8}$ to their lowest terms.

6. How can you tell without dividing whether a number is exactly divisible by 11?

## 76.

1. Find the amount of $7234.25 at 4½ per cent simple interest, in 22 years 2 months 20 days.

2. If 20 men build a wall 800 feet long, 10 feet high, and 18 inches thick in 14 days of 8 hours, how thick a wall will 15 men build 900 feet long and 15 feet high in 21 days of 9 hours?

3. Subtract 0.992748 from 1.

4. Find the cost of 3 acres 145 square rods of land, at $120 an acre.

5. What is the price of a silver bowl weighing 5 pounds 9 ounces 8 dwts., at $1.40 per ounce?

6. Add together $\frac{7}{16}$, $\frac{2}{3}$, $\frac{5}{48}$, $3\frac{19}{24}$.

## 77.

1. How many tiles, each 7 inches square, will be required to cover a floor 19 feet 3 inches by 13 feet 5 inches?

2. Extract the cube root of 0.145531576.

3. If a tradesman, by selling an article at $1.98, loses 17½ per cent, what should he have sold it for to gain 40 per cent?

4. What is the income of a man whose income tax at 4 *d.* in the pound amounts to 23 guineas?

5. If 2 horses can plough 7 acres of ground in a day, how many horses will plough 161 acres in 11½ days?

6. In 1,250,784 seconds, how many weeks, days, etc.?

## 78.

1. Divide 2054.95 by 0.0563.

2. A merchant sells tea to a tradesman at a profit of 60 per cent; but the tradesman, failing, pays only 12½ cents on the dollar. How much per cent does the merchant lose by the sale?

3. When a 3½ per cent stock is at 93, find what price a 4½ stock must bear that an investment may be made with equal advantage in either stock.

4. Find the cube root of 134,217,728.

5. Find the product of $10\frac{1}{8}$, $\frac{6}{13}$, $\frac{26}{27}$, and $1\frac{1}{8}$.

6. If 14 men can mow 168 acres in 12 days of 8¼ hours, how many acres can be mowed by 20 men in 11 days of $7\frac{1}{5}$ hours?

## 79.

1. Between the years 1841 and 1851, the population of England increased $14\frac{1}{5}$ per cent. In 1851, the population was 21,121,290. What was it in 1841?

2. A merchant has teas worth \$1.08 and 84 cents per pound respectively, which he mixes in the ratio of 3 pounds of the first kind to 2 of the second kind, and sells the mixture at \$1.04 per pound. What does he gain or lose per cent?

3. A person invests \$5460 in 3 per cent stock at 91; he sells out \$2000 stock when it has risen to $93\frac{1}{2}$, and the remainder when it has fallen to 85; he invests the proceeds in $4\frac{1}{2}$ per cent stock at 102. What is the alteration in his income?

4. Extract the cube root of 5.78 to three places of decimals.

## 80.

1. If 48 pioneers in 5 days of $12\frac{1}{2}$ hours can dig a trench $139\frac{3}{4}$ yards long, $4\frac{1}{2}$ yards wide, and $2\frac{1}{2}$ yards deep, how many hours a day must 270 pioneers work for 42 days, in order to dig a trench $4910\frac{1}{16}$ yards long, $4\frac{7}{8}$ yards wide, and $3\frac{1}{5}$ yards deep?

2. If a man rows 10 miles in $2\frac{1}{2}$ hours against a stream, the rate of which is 3 miles an hour, how long will he be rowing 5 miles with the stream?

3. Find the price of 5 acres 127 square rods and 88 square yards at $\$161\frac{1}{4}$ per acre.

4. If a person selling sugar at $9\frac{1}{2}$ cents per pound loses 10 per cent, what did he give per hundredweight?

## 81.

1. A square contains 40,092.0529 square feet. Find the length of one of its sides.

2. Simplify $\frac{(0.075 \times 0.075) - (0.005 \times 0.005)}{0.75 - 0.05}$.

3. A person invested \$4706 in 3 per cent stock at 90½. A year afterwards, when the 3 per cent stock had fallen to 89, he sold out one-half of his stock and reinvested it in 5 per cent foreign bonds at 52. What change did the reinvestment make in his income?

4. If 50 men dig a trench 120 yards long, 5 feet broad, 10 feet deep in 3 days of 10 hours, in how many hours will they dig a trench 175 yards long, 4 feet broad, and 8 feet deep?

5. Simplify $\frac{3\frac{1}{3} + 4\frac{1}{4} + 5\frac{1}{5}}{1\frac{2}{3} + 2\frac{1}{8} + 2\frac{3}{5}} \times \frac{3\frac{4}{7} + 4\frac{1}{16} + 4\frac{5}{9}}{7\frac{1}{7} + 8\frac{1}{8} + 9\frac{1}{9}}$.

## 82.

1. Find the least common multiple of 14, 36, 84, 108, 144.

2. Simplify $\frac{9\frac{7}{8} - 8\frac{6}{7} + 6\frac{5}{6} - 5\frac{4}{5}}{8\frac{9}{10} - 7\frac{13}{15} + 6\frac{7}{8} - 5\frac{6}{7}}$.

3. If with a capital of \$500 a tradesman gains \$50 in 7 months, in what time will he gain \$60.50 with a capital of \$385?

4. A certain 4½ per cent stock is at a discount of 23. What income should I get from \$385 invested in it?

5. Find the cost of papering the walls of a room 10 feet 8 inches wide, 19 feet 4 inches long, and 9½ feet high, with paper 2 feet wide at 5 cents a yard, allowing 10 yards of the paper for waste.

## 83.

1. If 1 inch of rain on 4840 square yards gives 18,200 gallons of water, how many gallons will 0.875 of an inch on a square mile give?

2. If the amount of property liable to income tax be 525 million pounds sterling, how many pence in the pound must the tax be to produce $17\frac{1}{2}$ million pounds?

3. The circumferences of two of the wheels of an engine are $25\frac{1}{2}$ feet and $16\frac{1}{2}$ feet respectively. How many more times will one turn round than the other in $4\frac{1}{2}$ miles?

4. If the shadow of an upright pole 9 feet high be $7\frac{1}{2}$ feet, what will be the height of a church spire which casts a shadow $247\frac{1}{2}$ feet long?

5. Simplify $\dfrac{\frac{4}{7}\text{ of }5\frac{3}{5}+\frac{1}{4}\text{ of }3\frac{1}{3}}{2\frac{1}{5}+1\frac{1}{12}} \div \dfrac{10\frac{1}{8}-8\frac{3}{4}}{6\frac{3}{4}-2\frac{1}{2}}$.

## 84.

1. Find the value of 3.75 of half-a-crown ($2\frac{1}{2}$ *s.*) + 4.4 of a guinea (21 *s.*) + 1.024 of £22.

2. Find the length in yards of the side of a square enclosure which contains 4 acres 144 square yards.

3. A plot of ground 50 yards long and 40 yards wide is to be covered with sods $1\frac{1}{2}$ feet long and 6 inches broad. If the sods cost 75 cents per hundred, what will be the expense for turf alone?

4. Find the present worth of $122.80 due 7 months hence, at 4 per cent.

5. In a town where the annual death rate is $2\frac{1}{2}$ per cent, the average number of deaths a week (52 weeks to the year) is 228. What is the population of the town?

## 85.

1. A person transfers $3000 from a 4 per cent stock at 90 to a 3 per cent stock at 72. How much 3 per cent stock can he purchase, and what will be the difference in his income?

2. A cistern 5 feet deep, 16 feet long, 4 feet 6 inches wide, is filled by one pipe in 45 minutes. In what time will a cistern 6 feet deep, 20 feet long, 5 feet wide, be filled by 3 similar pipes?

3. Multiply 0.416 by 0.025, divide the product by 3.25, and reduce the result to a common fraction.

4. A clothier gains 25 per cent by selling cloth at $5 per yard; but a bale of 80 yards being damaged, he has to reduce the price 10 per cent. What is now his profit on the bale, and his gain per cent?

5. Add $12\frac{1}{12}$, $13\frac{5}{16}$, $17\frac{2}{3}$, and $\frac{19}{144}$.

## 86.

1. Simplify $\frac{5\frac{1}{4}}{4\frac{1}{6}} \times \frac{1\frac{4}{11}}{2\frac{5}{21}} \div \frac{5\frac{2}{5}}{6\frac{5}{7}}$.

2. Find the difference between $\frac{3}{11}$ of 200 rods and $\frac{5}{16}$ of $\frac{1}{4}$ of a mile.

3. What fraction of 560 pounds is equal to $0.159\dot{0}$ of a long ton?

4. $13,000 of $3\frac{1}{2}$ per cent stock is sold at 98. How much money must be added to the sum realized in order to secure an equal income in 3 per cent stock at 87?

5. An army of 120,000 men lost 15 per cent by desertion to the enemy. What increase per cent did the enemy gain, their number previously being 64,000?

## 87.

1. In 1870 three towns had populations of 17,650, 19,600, and 18,760 respectively. In 1880, the population of the first had decreased 18 per cent, that of the second had increased 21 per cent, while the population of the three towns had increased by 4691. Find the change per cent in the population of the third town.

2. What fraction of $\sqrt{5\frac{4}{9}}$ is $\sqrt{0.000225}$?

3. Simplify $\dfrac{5\frac{1}{8} - 0.042 - 2.4 + 7\frac{5}{6}}{16\frac{2}{15} \div 60\frac{1}{2}}$.

4. Find the square root of 1,079,521 and 0.1079521.

5. What is the gain by investing $\$1950$ at $97\frac{3}{8}$ and selling out at 104, the brokerage on each transaction being $\frac{1}{8}$ per cent?

## 88.

1. Find the value of $\dfrac{3}{\sqrt{19} - 4}$ correct to four places of of decimals.

2. Find the simple interest on $\$281.60$ at $3\frac{1}{2}$ per cent for 4 years and 2 months.

3. By selling a carriage for $\$73.15$, I should lose 5 per cent. At what price must I sell it to gain 15 per cent?

4. Which is the better investment, 3 per cent stock at $64\frac{1}{4}$, or 5 per cent stock at $102\frac{3}{4}$?

5. A person has a certain capital, half of which is invested in 3 per cent stock at 90, and the other half in 5 per cent at 110. His total income is $\$6883.50$. What is his capital?

## 89.

1. At what rate per cent will a given sum of money double itself at simple interest in 30 years?

2. A grocer has tea, which he must sell at 84 cents per pound to gain 40 per cent. If he mixes it with tea which cost him 54 cents per pound, in the ratio of 7 of the best kind to 3 of the poorest, and sells the mixture in 10-pound packages at $7.76, how much does he gain per cent?

3. How many times is 224 pounds 2 ounces contained in 6 long tons 8 cwt. 8 pounds?

4. Find $\frac{1}{6}$ of 8 miles 145 rods 3 yards 1 foot 6 inches.

5. The sides of two squares contain 77 yards 1 foot 9 inches, and 7 yards 2 feet 4 inches, respectively. Find the side of a square whose area is equal to the sum of the areas of the two squares.

## 90.

1. If a railway journey of 177 miles 120 rods takes 3 hours 56½ minutes, what is the rate per hour?

2. Multiply 209 acres 145 square rods 3 square yards by 13.

3. Two wines worth $8 and $6 per gallon respectively are mixed together. If the mixture is worth $6.87½ a gallon, in what ratio are they mixed?

4. A tradesman pretends to charge 10 per cent above the wholesale price, but he has adulterated his goods with 50 per cent of a poorer kind, which costs only $\frac{2}{5}$ of the price. What is his real rate of profit?

5. Express as decimals $\frac{4}{33}$, $\frac{6}{55}$, and $\frac{8}{55}$.

## 91.

1. If the 2-penny loaf weighs 15 ounces when wheat is at 8 shillings, how is wheat selling when the 3½-penny loaf weighs 2 pounds?
2. Find exactly the cube root of $1,277,289\frac{27}{216}$.
3. Reduce $\frac{63327}{283997}$ to its lowest terms.
4. What fraction is 1 week 7 hours 12 minutes of the time from Jan. 1, 1800, to Feb. 26, 1864, both days inclusive?
5. Find the circulating decimal equivalent to $\frac{1}{1001}$.
6. At what rate per cent will a person receive interest who invests his capital in 3 per cent stock at 91?

## 92.

1. At what price must a person buy 8 per cent stock to receive interest at the rate of 3½ per cent?
2. If a vessel sails 500 miles in 2 days 18½ hours, how far will she sail between May 20 at noon, and 8 o'clock on the morning of July 10?
3. A person buys coffee at $24 per cwt., and chicory at $10 per cwt., and mixes them in the ratio of 2 of chicory to 5 of coffee. He retails the mixture at 30 cents per pound. What is his gain per cent?
4. A and B enter into partnership. A puts in $2100, B $1500. Four months after, C enters the partnership with $2700. At the end of the year the profit is 10 per cent on the whole capital. What share of the profit belongs to each?
5. If oranges are bought at the rate of 20 for 25 cents, how many should be sold for $12 to gain 40 per cent on the cost?

## 93.

1. Find the ratio of the rates for freight on two railroads, one of which charges $\$5.62\frac{1}{2}$ for carrying 4200 pounds 44 miles, and the other, $\$7.86\frac{1}{2}$ for carrying 5376 pounds $52\frac{1}{2}$ miles.

2. If the discount on $\$127.925$ for 20 days be $\$0.175$, find the rate per cent.

3. A gold wreath, weighing 3 pounds 7 ounces 12 dwt., cost $\$1275$. If it is made of gold worth $\$19.37\frac{1}{2}$ per ounce, what is charged for the manufacture?

4. Divide 24.109932 by 301.28.

5. Find the value of 0.90625 of a cubic yard.

6. Simplify $3\frac{1}{7} + 3\frac{3}{10} + 2\frac{3}{11} + 2\frac{5}{22} + \frac{3}{35}$.

## 94.

1. Reduce 18 days 5 hours 40 minutes 20 seconds to the fraction of 31 days 21 hours 30 minutes 10 seconds.

2. Show that the greatest common measure of two numbers is the least common multiple of all their common measures.

3. A bought 63 sheep, and sold $\frac{4}{9}$ of them at a profit of 15 per cent, $\frac{1}{7}$ at a profit of 50 per cent, and the rest at a loss of 25 per cent. What did he pay for the sheep, if his gain was $\$19.25$ on the whole?

4. Find the simple interest on $\$500$ for 8 years 3 months at $1\frac{1}{2}$ per cent.

5. Find the cost of 369 miles 120 rods 22 yards of telegraph wire at $\$73.33\frac{1}{3}$ per mile.

## 95.

1. What sum will amount to $5431.80 in 6 years at 4½ per cent simple interest?
2. Reduce 11 rods 4 yards 4.5 inches to the decimal of a mile.
3. Find the greatest common measure of 14,938, 23,474, 32,010.
4. Find the number of seconds from the beginning of the year 1883 to Dec. 17, 9 A.M., and express the result in words.
5. Extract the cube root of 5 to four places of decimals.

## 96.

1. Supposing the area of a circle to be 3⅐ times the square of the radius, find the weight of a circular disc of cast iron 7 feet in diameter, and 1⅛ inches thick, knowing that a plate 1 foot square and 1 inch thick weighs 37½ pounds.
2. If ⅛ of a sheep is worth $⅔, and ⅞ of a sheep is worth $\frac{1}{14}$ of an ox, what is the value of 100 oxen?
3. Find the entire surface of a cube, the volume of which is 14 cubic feet 705.088 cubic inches.
4. Find the cost of a draft for $400, payable 60 days after sight, exchange being ¼ per cent discount, and interest 7 per cent.
5. A man bought a horse for $125 and sold him for $100. What per cent of the cost of the horse did he lose?
6. Multiply 4 acres 67 square rods 19 square yards 4 square feet 72 square inches by 27.

## 97.

1. In what time will the simple interest on $375, at 4 per cent, amount to $91.25?

2. Divide the number 702 into 3 parts, proportional to $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$.

3. Divide 75 miles, 79 rods, 3 yards by 75.

4. How many bricks, each 9 inches by $4\frac{1}{2}$ inches by 3 inches are there in a pile 36 feet long, 9 feet wide, and 12 feet high?

5. Find the face of a draft, payable 60 days after sight, that can be bought for $1250, when exchange is at $\frac{1}{4}$ per cent premium, and interest 7 per cent.

6. Find the square root of 0.9 to four places of decimals.

## 98.

1. After paying $\frac{1}{5}$ of my money to one person, $\frac{1}{2}$ to another, and $\frac{1}{48}$ to a third, I had 7 cents remaining. How much had I at first?

2. A person walks at the rate of $3\frac{1}{2}$ miles an hour. Three hours after he has set out on a journey, he is followed by another person, walking at the rate of 5 miles an hour. In what time will he be overtaken?

3. A grocer mixes 72 pounds of tea at 69 cents a pound with 90 pounds of tea at 60 cents a pound. At what price per pound must he sell the mixture so as to gain 10 cents a pound?

4. Extract the cube root of $\frac{5}{9}$ to four places of decimals.

5. At what rate per cent will $3000 produce $250 interest in 1 year 2 months and 24 days?

## 99.

1. Find the interest of $1721.84 from April 1 to Nov. 12 at $4\frac{1}{2}$ per cent.

2. At what rate per cent will $1025.20 produce $25.72 interest in 4 months 9 days?

3. Find the principal that will produce $1339.28 in 2 years 7 months 24 days at 6 per cent compound interest.

4. Find the time in which $793.875 will amount to $805.84 at $5\frac{1}{2}$ per cent.

5. Find the proceeds of the following note:

DETROIT, Feb. 2, 1881.

Four months after date I promise to pay to the order of John Horn four thousand five hundred fifty and $\frac{36}{100}$ dollars, value received.

JAMES THORN.

Discounted at a bank at $5\frac{1}{2}$ per cent, Feb. 16.

## 100.

1. A bankrupt has goods worth $975, and, had they realized their full value, his creditors would have received $81\frac{1}{4}$ per cent of their claims; but $\frac{2}{5}$ of the goods were sold at $17\frac{1}{2}$ per cent, and the remainder at $23\frac{3}{4}$ per cent below their value. How many cents on the dollar did the bankrupt pay?

2. Find the value of 157 miles 144 rods of telegraph wire at $57.50 per mile.

3. Reduce $\frac{595}{1071}$, $\frac{1547}{6712}$ to their lowest terms, and express their difference as a decimal.

4. Extract the cube root of 1250.6894.

5. Extract to six places of decimals the square root of 19.

## 101.

1. If a person steps $80^{cm}$ at each step, how many steps will he take in walking round a square field containing $18^{ha}\ 625^{qm}$?

2. How many cords of wood can be piled in a woodshed 128 feet long, 42 feet wide, 12 feet high, allowing for a driveway 10 feet wide, running from one end of the building to the other?

3. The true discount on a bill of $470.89, due 4 years hence, is $85.62; find the rate per cent.

4. If the retail price of a book is $6, and 25 are sold for $102, what rate per cent of discount is allowed?

5. A merchant insures a cargo whose value is $4500 at 5 per cent. For what sum should he insure so as to cover both the loss of the cargo and the premium?

6. A man sent $500 to his agent in Chicago, with which to buy flour. The agent bought flour at $5 a barrel, charging $2\frac{1}{2}$ per cent commission for buying. How many barrels of flour can he buy, reserving for himself his commission, and how much money will be left over?

## 102.

1. Find the sum of $1871^{ccm}$, $541^{l}$, $4.51^{hl}$, and give the answer in liters.

2. What is the commission on goods worth $767.73 at $7\frac{1}{2}$ per cent?

3. Required the equated time for the payment of $700 due in 6 months, $800 due in 9 months, and $600 due in 10 months.

4. When 3 per cent stock is at $91\frac{1}{4}$, find how much can be bought for $540, allowing $\frac{1}{8}$ per cent commission upon the stock bought.

5. Find the cube root of 0.75 to four places of decimals.

6. If 2 men can reap $2\frac{1}{2}$ acres in $2\frac{3}{4}$ days, how long will it take 11 men to reap 15 acres?

## 103.

1. If it takes 25 minutes for a man who reads 2 pages in 3 minutes to read a certain document, how long will it take a man who reads a page a minute to read a document 3 times as long?

2. A man sells $7500 of 6 per cent railway stock at 120, and invests half the proceeds in 3 per cent stock at 93, and the other half in 5½ per cent stock at 90. Find the alteration in his income.

3. A piece of land 2449$^{m}$ square is sold for $35 a hektar. How much does the land bring?

4. If cloth is sold for $3.75 a yard at a loss of 10 per cent, what should be the selling price a yard to gain 18 per cent?

5. Find the cube root of 0.3 to four places of decimals.

## 104.

1. A company whose capital is $2,500,000 pays an annual dividend of 6½ per cent, besides paying a tax of 1½ per cent on its whole capital. Find the total annual receipts, the expenses being 60 per cent of the gross receipts.

2. Bought 4 lots of wool at $652.50 each, and sold the whole at 20 per cent profit. What was the selling price per lot?

3. If the increase in the number of male and female criminals is 1⅘ per cent, while the decrease in the number of males alone is 4⅗ per cent, and the increase in the number of females is 9⅘ per cent, find the ratio of male criminals to female criminals.

4. Find the cost of a carpet 75$^{cm}$ wide, at $4.25 a meter, for a room 5.25$^{m}$ long, and 4.75$^{m}$ wide, strips running across the room, if there is a total waste of 3$^{m}$ in matching the pattern.

5. Extract the square root of 0.2 to five decimal places.

## 105.

1. An army lost 18 per cent of its strength by sickness and desertion, and then lost 14 per cent of the remainder in battle. The number left was 84,624. Of how many did the army originally consist?

2. If 6 iron bars 4 feet long, 3 inches broad, and 2 inches thick weigh 288 pounds, how much will 15 weigh, each $6\frac{1}{2}$ feet long, 4 inches broad, and 3 inches thick?

3. Find the cost of plastering a room $13^{m}$ long, $12^{m}$ wide, and $7^{m}$ high, at 30 cents a square meter, if $115^{qm}$ are allowed for base-board, doors, etc.

4. Find the cube root of 25 to three places of decimals.

5. In 1841, the population of Great Britain was 21,476,000, and that of Ireland 7,310,000. In 1851, the population of Great Britain had increased 8.45 per cent, and that of Ireland had decreased 12.5 per cent. Find the increase per cent in the population of the whole kingdom.

## 106.

1. A ship, valued at \$14,500, is insured at $3\frac{1}{2}$ per cent, and her cargo, valued at \$32,000, is insured at 5 per cent. Find the whole cost of insurance.

2. Into how many pills of $325^{mg}$ each can a mass of $23.4^{g}$ be made?

3. The solid contents of a cube is 37 cubic feet, 64 cubic inches. Find the cost of painting its outside at $33\frac{1}{3}$ cents per square foot.

4. What must be the side of a cubical cistern, which will contain exactly 1000 imperial gallons of water, if an imperial gallon contains 277.274 cubic inches?

5. If a compound consist of 1185 parts copper, 715 parts tin, and 100 parts zinc, find the percentage of each metal in the compound.

## 107.

1. A rectangular cistern 9 feet long, 5 feet 4 inches wide, 2 feet 3 inches deep is filled with a liquid that weighs 2520 pounds. How deep must a cistern be that will hold 3850 pounds of the same liquid, if its length is 8 feet, and its width 5 feet 6 inches?

2. Reduce to prime factors, and then find the greatest common measure of 35,035, 41,580, 24,255.

3. How many square slabs of marble $150^{qcm}$ on the surface will be required to pave a court whose area is $50.70^{qm}$?

4. A person sells out his 3 per cent stock at 86¼, and gets $34,000; he invests one half of this sum in 4 per cent stock at 97, and the remainder in 3½ per cent stock at 94. Find the alteration in his income.

5. If 56 cubic feet 1044 cubic inches of timber are required to floor a room 29¼ feet by 25⅓ feet, what is the thickness of the boards?

## 108.

1. A merchant has teas worth $1.12½ and 87½ cents per pound respectively, which he mixes in the ratio of 3 pounds of the better kind to 2 of the poorer kind, and sells the mixture at $1.08⅓ per pound. What does he gain or lose per cent?

2. How many revolutions will the wheels of a carriage make in travelling $41^{km}$, if the wheels are $125^{cm}$ in diameter? (The circumference is 3.1416 times the diameter.)

3. In what proportion must wines worth $3, $4, $5.20, $6, per gallon be mixed, so as to give a profit of 14⅔ per cent when sold for $4.80 a gallon?

4. Extract to four figures the cube root of 20.

5. If a railway train goes 27¾ miles in 2½ hours, how far will it go in an hour?

## 109.

1. In what time will $2275 amount to $2673.12½ at 5 per cent, simple interest?

2. If a horse trots 23¾ miles in 2½ hours, what is his rate per hour?

3. If twelve men can build a wall 6 feet high, 3 feet thick, in 9 days, how many men would build a wall of the same length, 5 feet high, 4 feet thick, in 24 days?

4. A man pays $12,000 for 5$^{a}$ of land, and sells it for $25.20 a square meter. How much does he make?

5. A river 30 feet deep and 200 yards wide flows 4 miles an hour. Find the number of cubic feet of water that passes a given point in a minute.

6. Extract to four figures the cube root of 0.002.

## 110.

1. A cistern has two pipes, one of which can fill it in 2 hours, the other in 3 hours. A third pipe can empty it in 5 hours. If all these are opened when the cistern is empty, in what time will it be filled?

2. A pile of wood is 8.50$^{m}$ long, 2.66$^{m}$ wide, 2.60$^{m}$ high. How many sters of wood are there?

3. A clock is set at 12 o'clock on Monday; at noon on Tuesday it is 3 minutes too fast. What will be the true time when the clock strikes 4 on Thursday afternoon?

4. If 20 men can do a piece of work in 12 days, how many men will do another piece of work six times as great in $\frac{1}{10}$ of the time?

5. If 5 per cent be lost by selling an article at $2.50, find the gain or loss per cent by selling it at $3.12½.

6. Find the square root of 53107.2025.

## 111

1. Reduce 167,948,604 square inches to acres, etc.
2. A man contracts to perform a piece of work in 30 days, upon which he employs 15 men. In 24 days it is only half finished. How many additional men must he employ to finish the work in time?
3. A cistern can be filled by a spout in 2 hours, but on account of a leak in the cistern the spout takes $2\frac{1}{2}$ hours to fill it. How long will it take the leak to empty the cistern?
4. A country, the population of which is 10 millions, has births yearly of 1 in 20, and deaths 1 in 30. What will its population be 5 years hence?
5. A beam is $14.14^{m}$ long. Its other dimensions are $51.6^{cm}$, $174^{mm}$. Find its volume.
6. If a trader sells $13\frac{1}{2}$ pounds for 14 pounds, how much per cent does he gain fraudulently?

## 112.

1. A wine which contains $7\frac{1}{2}$ per cent of spirit is frozen, and the ice, which contains no spirit, is removed. The proportion of spirit in the wine thus is increased to $8\frac{3}{4}$ per cent. How much water in the shape of ice is removed from 504 gallons of the original wine?
2. Find to four places of decimals the square root of 0.001 and of 0.5; and also find what numbers have 0.1 and 0.03 for their square roots.
3. The diameter of a carriage wheel is 4 ft. Two persons calculate the number of its turns in a given distance, one calling the circumference 3 times the diameter, the other $3\frac{1}{7}$ times; their results differ by 100 turns. Find the distance.
4. A package of candles which weighs $465^{g}$ is sold for 28 cents. What is the price of $10^{kg}$ of the candles?
5. Reduce to its lowest terms the product of $1+\frac{1}{4}+\frac{1}{9}+\frac{1}{16}+\frac{1}{25}+\frac{1}{36}$, and $\frac{3}{13}-\frac{1}{7}+\frac{8}{59}$.

## 113.

1. Resolve into prime factors 5940, 19,008, and 269,568, and write the greatest number that will divide them all without remainder, and the smallest number that they will all divide without remainder.
2. Divide 181.3 by 0.00037, and by 37,000.
3. Find the cost of carpeting a room 18 feet 6 inches long, 12 feet 6 inches wide, with carpet $\frac{3}{4}$ of a yard wide, at 75 cents per yard, strips running lengthwise, and 3 yards being allowed for matching the patterns.
4. If 3 men mow 20 acres in 11 days of 11 hours, how many men will it take to mow a rectangular field 384 yards long and 300 wide, in 4 days of 12 hours?
5. The difference between the simple and compound interest on a sum for 3 years at 5 per cent is \$23.12½. Find the sum.
6. How many hektars in a square kilometer?

## 114.

1. A box is $3.75^{m}$ long, $3.50^{m}$ wide, and $50^{cm}$ high. Find how many liters of olive oil it will hold, and the weight of the oil in kilograms, the specific gravity of the oil being 0.914.
2. If A can do $\frac{3}{4}$ of a piece of work in 4 hours, and B can do $\frac{2}{3}$ of the remainder in 1 hour, and C finish it in 20 minutes, in what time will they do it, all working together?
3. When a common fraction is reduced to a decimal, in what cases will the result be a terminating decimal, and in what cases a circulating decimal?
4. If by selling goods for \$272 I lose 15 per cent, how much per cent would I have lost or gained if I had sold them for \$336?
5. If oranges are bought at the rate of 20 for a dollar, how many should be sold for \$28 to gain 40 per cent?
6. Find the cube root of 84.9 to three places of decimals.

## 115.

1. If a man walk 11 yards in 5 seconds, how long will he be in walking a mile?

2. A cubic foot of water weighs 62½ pounds, and a room 18 feet 9 inches by 13 feet 4 inches is flooded to a depth of 2 inches. What is the weight of water in the room?

3. Assuming that 3 hektars contain 35,881 square yards, and that one hektar contains 10,000 square meters, find the length of a meter in yards.

4. Add together 536.421, 53,642.1, 5.36421, and subtract the result from 100,000.

5. If the price of candles 8½ inches long be 18 cents for a half-dozen, and that of candles of the same thickness and quality 10½ inches long be 22 cents a half-dozen, which kind would you advise a person to buy, and what would be the saving per cent if your advice is followed?

## 116.

1. Find the weight in kilograms of the air in a hall $23^m$ long, $16^m$ wide, and $10^m$ high, the specific gravity of air being 0.00129206.

2. A cubical block contains 9 cubic feet, 1029 cubic inches. Find the number of square yards, etc., in its surface.

3. A bar of metal weighing 100 ounces 16 dwts. is made into coins, each weighing 1 ounce 8 dwts. How many coins are there?

4. A person investing in a 3 per cent stock received 3½ per cent interest on his money. What is the price of the stock?

5. A bar of gold, weighing 196 pounds 10 ounces 10 dwts., is cased in lead, weighing 24 pounds 14 ounces. Find the weight of the whole in Avoirdupois weight.

## 117.

1. A merchant buys 4000 bushels of wheat, one-fifth of which he sells at a gain of 5 per cent, one-fourth at a gain of 10 per cent, one-half at a gain of 12 per cent, and the remainder at a gain of 16 per cent. If he had sold the whole at a gain of 11 per cent, he would have made $35 more. What was the cost of the wheat per bushel?

2. If 1000 square yards of land produce a load of hay, how many loads will 25 acres produce?

3. Assuming 8000 meters to be equal to 5 miles, find the number of square meters there are in an acre.

4. A person having a certain sum of money to invest finds that an investment in 5 per cent stock at 117½ will yield him $29 more interest annually than an investment in 3 per cent stock at 92½. How much money has he to invest?

5. Find the simple interest on $281.63 at 3½ per cent for 4 years and 2 months.

## 118.

1. A freight train is 8 miles ahead of an express that travels at the rate of a mile in 1½ minutes. 20 minutes later the express runs into the freight train. At what rate is the freight train running?

2. A man bought 240 cows at Rotterdam, paying $71.50 for each. He paid $\frac{1}{22}$ of their cost for their transportation, and exchanged them for 299 horses which he sold for $75 apiece. What did he gain per cent on his expenditure?

3. If a square field contain 10.24$^{ha}$, find the length of its side in meters.

4. Find the amount for $512 for 3 years at 6½ per cent, compound interest.

5. If a field containing 5½ acres produces 112 bushels of wheat, what is the area of a field which will produce 400 bushels of wheat at the same rate?

## 119.

1. Multiply 4 acres 67 square rods 19 square yards 4 square feet 72 square inches by 27.

2. What is the weight of a cubic centimeter of water? of a liter of water? of a cubic meter of water? If a cubic meter of gravel weighs 2.11 metric tons, what is its specific gravity?

3. If 7 men, working 16 days, can mow a field 1320 yards long, and 880 yards wide, what will be the length of the side of a field 1320 yards wide, which 4 men can mow in 42 days?

4. Divide 1.765 by 2470 to five places of decimals.

5. If 8 acres produce 220 bushels of corn, how much will 22 square yards produce?

## 120.

1. If 3 acres of land cost $465.90, how much can be bought for $6716.725?

2. From 0.315 of a gallon take 2.25 pints.

3. $19.68\frac{3}{4}$ is $2\frac{1}{12}$ per cent of what sum?

4. A, B, and C rent a farm for $270. A puts 200 sheep on it; B, 150; and C, 100. After 6 months A sells $\frac{3}{4}$ of his flock to C, and 3 months later B sells $\frac{3}{5}$ of his to A. How much of the rent should each pay at the end of the year?

5. How many times a minute does the wheel of a carriage turn, when the carriage is driven at the rate of $14^{km}$ an hour, and the diameter of the wheel is $120^{cm}$?

## 121.

1. If a man walks $11^m$ in 5 seconds, how many kilometers can he walk in an hour at the same rate?

2. Find the cost of repairing a road 87 yards 1 foot 10 inches long, at the rate of $4 a rod.

3. A cask that weighs 236 pounds 4 ounces *just* sinks in a square cistern of water, whose edge is 2 feet 6 inches. If the cask is removed, how far will the water sink in the cistern, reckoning the weight of a cubic foot of water to be 1000 ounces?

4. A man paid $45.10, including a duty of 10 per cent, for a watch. How much was the duty?

5. If 19 men can build 38 yards of wall in 12 days, how many will build 96 yards 2 feet 3 inches in $21\frac{1}{2}$ days?

## 122.

1. Find the amount of $875 at the end of 1 year and 3 months, at 4 per cent per annum, compound interest, the interest accruing quarterly.

2. If 12 men build a wall 60 feet long, 4 feet thick, and 20 feet high in 24 days, working 12 hours a day, how many men will it take to build a wall 100 feet long, 3 feet thick, and 12 feet high, in 18 days, working 8 hours a day?

3. If the specific gravity of sea-water is 1.026, and that of olive oil is 0.915, what is the weight of a hektoliter of each in kilograms?

4. What must be the length of an inner edge of a cubical box which will hold 10 cubic feet?

5. An agent, charging $2\frac{1}{4}$ per cent commission, receives for his services $313. Find the amount of his sales.

## 123.

1. An agent received $5922 with which to purchase goods, and is allowed 5 per cent commission on his purchase. If the $5922 covers the cost of the goods and his commission, how much was his commission?

2. How much per cent above cost must a man mark his goods in order that he may take off 30 per cent from the market price, and still make 30 per cent on the cost?

3. If a pint contains $28\frac{7}{8}$ cubic inches, how many pints are there in a cubic foot of water?

4. If 14 liters of water be poured into a vessel containing 6 liters of sulphuric acid, specific gravity 1.84, and the mixture shrink to 19.944 liters, what is the specific gravity of the mixture?

5. Find 0.015 of 17 acres 130 square rods.

## 124.

1. If 5 needlewomen can finish a certain quantity of work in $10\frac{5}{8}$ days of $9\frac{3}{5}$ hours each, how long would it take 3 needlewomen to do twice the same work, reckoning 10 hours to the day?

2. Find the square root of 0.196 to four places of decimals.

3. Find the greatest common measure of 837, 1134, and 1347.

4. A ship carries 5 chronometers, and estimates Greenwich time by the mean time of the five. Two of them lose respectively 39 seconds in 35 days, and 4.3 seconds in 6 days; the others gain respectively 5 seconds a week, 1.3 seconds a day, and 23 seconds in 14 days. By how much will the estimated time be in error after a cruise of 176 days?

5. How many square meters of surface will 240 sheets cover, if the sheets are $303^{mm}$ long and $195^{mm}$ wide?

## 125.

1. A bankrupt owes $5050. His assets are $378.75. How many cents does he pay on a dollar?

2. If 36 men dig a trench 72 yards long, 4 yards wide, and 3 yards deep, how many men will be required to dig one 80 yards long, 4 yards wide, and 6 yards deep in the same time?

3. Reduce to its simplest form the expression
$\frac{3}{7}$ of $\frac{4\frac{5}{9}}{12\frac{1}{8}}$ of $\frac{3\frac{4}{11}}{11\frac{5}{7}} \div 1\frac{1}{11}$.

4. A person invests $6534 in 3 per cent stock at 90, and on the stock rising to 91 transfers his stock to $3\frac{1}{2}$ per cent stock at $93\frac{1}{2}$. How is his annual income affected?

5. Olive oil costs 60 cents a kilogram. What is the price of a hektoliter, if the specific gravity of the oil is 0.914?

## 126.

1. The distance between two places measured on a military map is 156$^{mm}$. What is the actual distance between the places if the map is made on the scale of 1 to 80,000?

2. How many horses will be required to plough 117 acres in 35 days, if 10 horses can plough 13 acres in 7 days?

3. If I buy 3090 yards of cloth at $92\frac{1}{2}$ cents per yard, and sell the whole for $3205.87\frac{1}{2}$, what is the gain per cent?

4. Find the amount of $7123.13 at 4 per cent, for 2 years and 3 months, compound interest.

5. How many bricks $8\frac{1}{4}$ inches long, $4\frac{1}{4}$ inches wide, $2\frac{1}{2}$ inches thick can be stored in a building $17\frac{1}{2}$ yards long, 10 yards wide, and $8\frac{1}{2}$ feet high?

## 127.

1. How many panes of glass $40^{cm}$ by $80^{cm}$ will be required for the windows of a house if the total surface of measurement of the glass in the windows is $203.52^{qm}$?

2. A 20 horse-power engine pumps 40 gallons of water from a pit 100 yards deep in 3 hours. What quantity of water will an engine of 35 horse-power pump from a depth of 235 feet in 141 days, working night and day?

3. A speculator buys 280 yards of carpet, expecting to sell the whole at \$1.38 a yard, and thereby make 15 per cent profit; but 40 yards being ruined, what did he gain or lose per cent by selling the remainder at the expected rate?

4. If a piece of land is bought for \$3500, and a man who owns $\frac{2}{5}$ of it sells $\frac{1}{2}$ of his share for \$800, how much does he gain per cent by the transaction?

5. Extract the cube root of 1.105507304.

## 128.

1. A tank is $1.50^{m}$ wide, $3.20^{m}$ long, and $80^{cm}$ deep. How many kilograms of alcohol, specific gravity 0.80, will be required to fill it one-third full?

2. How many men working for 11 cents an hour for 23 days of 9 hours can earn the same wages as 22 men working for $11\frac{1}{2}$ cents an hour for 18 days of $9\frac{1}{2}$ hours.

3. If goods cost \$75.87½, at what price must they be sold to gain $17\frac{1}{2}$ per cent?

4. A can mow $\frac{2}{5}$ of a field in $7\frac{1}{2}$ days, B can mow $\frac{3}{5}$ of the same field in $9\frac{1}{2}$ days. In what time can A and B together mow the field?

5. A train travels a certain distance in $4\frac{7}{12}$ hours at the rate of $16\frac{4}{5}$ miles an hour. How long will a train going $19\frac{1}{4}$ miles an hour take to travel the same distance?

## 129.

1. A rectangular sheet of tin of uniform thickness is $85^{cm}$ wide, $2.7^{m}$ long, and weighs $536^{g}$. What is its thickness, reckoning the specific gravity of tin at 7.3?
2. I pay for 180 yards of cloth at $92\frac{1}{2}$ cents per yard, but it is measured with a yard-stick $\frac{1}{8}$ of an inch short. How much money does the seller unfairly take?
3. What must a person have invested in 3 per cent stock at $93\frac{1}{2}$, if a transfer of $\frac{2}{5}$ of his capital to 5 per cent stock at 125 would increase his income \$14.80?
4. If 20 shillings weigh 3 ounces 12 dwts. 12 grains, and contain 5 dwts. $10\frac{1}{2}$ grains alloy, how much pure silver is there in a half-crown ($2\frac{1}{2}$ shillings)?
5. Express by a common fraction the difference between $2.5\dot{3}\dot{5}$ and 2.535.

## 130.

1. A, B, and C rent a field for \$25.62. A puts in 15 sheep for 6 months, B 45 sheep for 8 months, C 81 sheep for 4 months. What should each pay toward the rent?
2. The top of a building 236 feet high is reached by a flight of steps, each $12^{cm}$ high. Find the number of steps, if a meter is taken as equal to 3 feet $3\frac{1}{3}$ inches.
3. How many ars of land in a strip $1^{km}$ long and $7^{m}$ wide?
4. An executor of an estate finds it encumbered with debts to the amount of \$4322.50 over and above its realized value of \$10,729.50. How many cents on a dollar can he pay the creditors?
5. Extract the cube root of 437.245479.

## 131.

1. What fraction of a pound avoirdupois is a pound Troy, and what fraction of an ounce Troy is an ounce Avoirdupois?

2. Simplify $\left(\frac{3 \times 4\frac{1}{6}}{7\frac{1}{2} + 4\frac{2}{5}} + \frac{3\frac{1}{2} + 8\frac{5}{6}}{3\frac{7}{9} - 2\frac{1}{6}}\right) \div \frac{\frac{3}{4} \text{ of } \frac{4}{5}}{\frac{5}{4} \text{ of } 3}$.

3. Find the weight in kilograms of a bar of gold $10^{cm}$ long, $30^{mm}$ wide, and $25^{mm}$ thick, its specific gravity being 19.36.

4. If \$15 be gained on \$360 in 8 months 15 days, what sum will gain \$21 in 1 year 6 months?

5. For how much must a man give his note to a bank, on 4 months at 6 per cent, to obtain \$500?

## 132.

1. What sum will amount to \$1104.75 in 3 years at $3\frac{1}{3}$ per cent, compound interest?

2. What annual income will be produced by \$13,000 in a $3\frac{1}{2}$ per cent stock at 91?

3. If the circumference of a coach-wheel measures 17 feet 7.2 inches, how often will it turn round in travelling 8 miles 264 feet?

4. Reduce to its lowest terms $\frac{1887}{6993}$.

5. If a square meter = 1550.031 square inches, find to the fifth decimal place the number of square centimeters in a square inch, and the number of acres in a hektar.

## 133.

1. A tradesman's prices are 20 per cent above cost price. If he takes 10 per cent off from the bill of a customer, what per cent profit does he make?
2. If a man can do a piece of work in 77 hours, and a boy can do the same work in 121 hours, in how many hours, minutes, and seconds can they do it, working together?
3. If the cost of papering a room $8\frac{1}{4}$ yards long, $6\frac{2}{3}$ yards wide, with paper 2 feet wide at 8 cents a yard be \$14.32, find the height of the room.
4. If 3 per cent more be gained by selling a horse for \$83.25 than by selling him for \$81, what is the cost of the horse?
5. If a cubic yard $= 0.76453^{\text{cbm}}$, find to the fifth decimal place the number of cubic centimeters in a cubic inch, and the number of sters in a cord.

## 134.

1. By selling out \$4500 of 5 per cent stock at $112\frac{1}{2}$, and investing the proceeds in a 7 per cent stock, a person increases his income by \$168.75. What is the price of the 7 per cent stock?
2. Simplify $2\frac{37}{55} \times \frac{43089}{77506}$.
3. If a gram $= 15.43235$ grains, find to the fifth decimal place the number of pounds Avoirdupois in a kilogram and in a metric ton.
4. An article which costs \$95.76 per cwt. of 112 pounds is retailed at \$1.08 a pound. If there is a waste of 5 per cent, what is the rate per cent of profit?
5. Find the square root of 0.1 to four places of decimals.

## 135.

1. Find the L. C. M. of 7, 11, 21, 63, 91, 99, 117.

2. A plate of iron 137$^{cm}$ long, 643$^{mm}$ wide, 43.1$^{mm}$ thick weighs 277.54$^{lbs}$. What is its specific gravity?

3. If 135 men can dig a trench 48 yards long, 1 foot 3 inches wide, 3 feet 9 inches deep, in 5 days of 6 hours, how many men will be required to dig a trench 90 yards long, 2 feet 6 inches wide, 3 feet deep, in 27 days of 10 hours?

4. A man has £10 13*s.* 4*d.* a week in rents. His tenants cheat him out of $\frac{1}{10}$ of his rent; he pays 4*d.* in the pound for collection, and 9½ *d.* in the pound for taxes. How much a week has he to spend?

5. Divide 4900 by 0.07, multiply the quotient by 0.63, and divide the result by 0.049.

## 136.

1. If $\frac{5}{12}$ of a cargo be worth $750, how much is $\frac{8}{10}$ of $\frac{5}{36}$ of it worth?

2. A parcel of 5 pounds 7 ounces is carried 120 miles for 40 cents. How much will it cost to carry 16 pounds 5 ounces a distance of 90 miles at the same rate?

3. If a meter = 39.37043 inches, find to the fifth decimal place the number of centimeters in an inch, and the number of kilometers in a mile.

4. Find the cube root of 7.6 to four places of decimals.

5. A person, by selling an article which cost 60 cents a pound at 67½ cents a pound, makes 5 per cent more profit than if he had sold the whole for $267.67½. Find the amount sold.

## 137.

1. Find the sum of $6\frac{1}{2}$, $7\frac{4}{15}$, $8\frac{7}{12}\frac{2}{5}$, 19, $10\frac{11}{15}$, $12\frac{5}{8}$.

2. A garrison of 1000 men, provisioned for 60 days, was reinforced at the end of 18 days, and the provisions were exhausted at the end of 30 days from that time. Of how many men did the reinforcement consist?

3. Two engines 40 miles apart are approaching each other at the rates of 25 and 35 miles an hour. Determine the time and place of their meeting.

4. Find the simple interest on \$2187.50 for 219 days at $4\frac{1}{2}$ per cent, reckoning 365 days to the year.

5. Find the area of a field $225^{m}$ long, $100^{m}$ wide. Express the answer in hektars and ars.

## 138.

1. From 2000 subtract 852.2534, and divide the remainder by 16.38.

2. If I invest \$1200 in 3 per cent stock at 72, what is my income, and what rate per cent do I get on my investment?

3. If \$36 worth of bread will be sufficient for 12 men 8 months, when corn is \$1 per bushel, how many men will require \$100 worth of bread for 12 months, when corn is $\$1.31\frac{1}{4}$ per bushel?

4. Find the time required to travel $31^{km}$ $150^{m}$, at 1 minute 28 seconds a kilometer.

5. A broker receives \$6150 to invest in cotton at $10\frac{1}{4}$ cents a pound. His commission is $2\frac{1}{2}$ per cent for buying. How many pounds of cotton can he buy?

## 139.

1. A collector's commission for collecting taxes, at $1\frac{1}{2}$ per cent, is $41.31. What is the sum collected?

2. How many yards of carpeting 2 feet 8 inches wide will be required for a floor 19 feet 7 inches long, 16 feet 9 inches wide, if the strips run across the room, and $2\frac{1}{3}$ yards are allowed for waste in matching the pattern.

3. Find the value of a carboy (17$^{l}$) of sulphuric acid, specific gravity 1.841, at 5 cents a kilogram.

4. If the ratio of the circumference to the diameter be 3.1416, find the diameter of a cylinder whose circumference is $16\frac{1}{2}$ feet.

5. How much more income will a person have by transferring $3975 of 3 per cent stock into $3\frac{1}{2}$ per cent stock, if the price of the 3 per cent stock is $93\frac{3}{4}$, and of the $3\frac{1}{2}$ per cent stock $99\frac{3}{8}$?

## 140.

1. Find the bank discount upon a note of $587, given Feb. 29, 1880, for 3 months, and discounted April 30 at $6\frac{1}{2}$ per cent.

2. Determine the number of cubic meters in a box 2 yards long, 1 yard wide, and $2\frac{1}{2}$ feet deep, reckoning a cubic yard $= 0.76453^{cbm}$.

3. A reservoir is 24 feet 8 inches long, and 12 feet 9 inches wide. How many cubic feet of water must be drawn off to make the surface sink one foot?

4. Divide 200 acres into four parts proportional to the numbers 50, 35, 80, and 9.

5. Extract the cube root of 946,966,168.

## 141.

1. If coffee worth 66 cents, 77 cents, and 57 cents per pound be mixed in equal quantities, and the mixture sold at 70½ cents per pound, what is the gain or loss per cent?

2. If 3 men, working 11 hours a day, can reap 20 acres in 11 days, how many men, working 12 hours a day, will reap a field 360 yards long and 320 yards broad, in 4 days?

3. Find in yards the side of a square field containing 15 acres 109 square rods 3 square yards.

4. A man walks 10½ miles the first day, 16¼, 18⅙, 27⅛, 21¼ miles on the four following days respectively. He then returns home by the same road in four days. What was his average daily walk on his way home and on his whole journey?

5. How many tons of air, specific gravity 0.00129206, in a space $70^m$ by $50^m$ by $35^m$?

## 142.

1. By selling a horse for $64.75, I lost 7½ per cent. What per cent should I have gained by selling him for $73.50?

2. The proceeds of the income tax at 5*d.* in the pound was equal to £5,250,000. How much would the proceeds be, if the tax was 5 per cent?

3. Find the number of liters in a vat $2^m$ by $75^{cm}$ by $50^{cm}$. Also find the weight in kilograms of sulphuric acid, specific gravity 1.840, required to fill it.

4. One horse goes 1¼ miles in 2 minutes 26 seconds; another, 1¾ miles in 3 minutes 36 seconds. How much per cent does the first one go faster than the second?

5. Find the greatest common measure of 1⅝, 2½, 4, and 5½.

## 143.

1. Find the least common multiple of $\frac{1}{15}$, $2\frac{1}{2}$, 5, $6\frac{1}{3}$, and $\frac{1}{11}$.

2. By selling goods for \$116.85 I lose 5 per cent. For what should I sell them to gain $3\frac{3}{4}$ per cent?

3. A spends $\frac{1}{3}$ of his money, then $\frac{1}{3}$ of the remainder, and then $\frac{1}{4}$ of what he has left. He finally has \$25. How much had he at first?

4. Make out a bill and receipt it, and show how much change there will be from a twenty-dollar bill:

   $3\frac{1}{2}$ cwt. of coal, at 21 cents a cwt.; 13 pounds of cheese, at $15\frac{1}{2}$ cents per pound; $2\frac{3}{4}$ pounds of tea, at 80 cents per pound; 17 pounds of sugar, at 11 cents per pound; $3\frac{1}{2}$ yards of flannel at 47 cents per yard; 29 yards of gingham at $21\frac{1}{2}$ cents a yard.

5. Find the number of sters in a pile of wood $4.50^{m}$ long, $2^{m}$ wide, and $2.50^{m}$ high.

## 144.

1. If 7 men earn \$31 in $9\frac{1}{4}$ days, how much will 17 men earn in $20\frac{1}{7}$ days?

2. Two persons have each a capital of \$12,000. The one invests in 3 per cent stock at $90\frac{5}{8}$; the other in 5 per cent stock at $103\frac{3}{4}$. What is the difference in their incomes?

3. If I buy 14 sheep for \$157.29, and sell 6 of them for \$7.20 each, for how much a head must the remainder be sold, that I may gain 4 per cent on the whole?

4. Find the G.C.M. of 1908, 936, 630, 21,294, 306.

5. A hektoliter of rape-seed weighs $63^{kg}$, and $32^{l}$ of oil can be extracted from it. How many kilograms of the seed will it take to make a hektoliter of the oil?

## 145.

1. The volume of a cube is 2 cubic yards 14 cubic feet 145 cubic inches. Find its edge, and also its diagonal to two places of decimals.

2. By using false weights a grocer receives 17 cents instead of 16 cents. Find the number of ounces in his false pound, and his gain per cent.

3. A railway pays 3½ per cent dividend. At what price will its shares give 4½ per cent to a purchaser?

4. A person sells his 3 per cent stock for 73½, and buys with the proceeds 3½ per cent stock at 81½, thereby increasing his income $4.50. How much 3 per cent stock has he?

5. Reduce 150 hektars to acres, supposing a square meter equal to 1.196 square yards.

## 146.

1. A profit of $127.60 is made by selling 2552 pounds of butter at 45 cents a pound. Find the cost per pound and the gain per cent.

2. For what sum must I insure goods worth $2192 at 2½ per cent, so as to cover their value and the premium paid?

3. If $11.20 worth of paper is required for a room 25 feet 3 inches long, 19 feet 9 inches wide, and 12 feet high, when the paper is ¾ of a yard wide, find the cost of each yard of paper.

4. Find the price of paving a courtyard 25.34$^{m}$ long, 18.36$^{m}$ wide, at $1.08 per square yard. (Square meter = 1.196 square yards.)

5. Find within an inch the diagonal of a square field containing 3½ acres.

## 147.

1. Find the difference between 30 chains, 15 links, and 126 rods. Express the answer in yards and decimal of a yard.

2. Find the number of feet, board measure, in a stick of timber 15 inches square and 32 feet long.

3. A watch is 10 minutes too fast at noon on Monday, and loses 3 minutes 10 seconds a day. Find the time indicated by the watch when the true time is a quarter past ten on the Sunday morning following.

4. Find the cost of 5 acres 127 square rods 88 square yards at $\$161.33\frac{1}{3}$ per acre.

5. Find the weight in metric tons of a block of stone $12.37^{m}$ long, $7.14^{m}$ wide, $83^{cm}$ thick, if the specific gravity of the stone is 2.5.

## 148.

1. From two places which are 154 miles apart two persons set out to meet each other, one walking at the rate of 3 miles in 2 hours, the other 5 miles in 4 hours. In how many hours will they meet?

2. A regiment was reduced to 520 men after engaging in two battles, in the first of which it lost 1 man in every 25, and in the second $\frac{5}{18}$ of the remainder. How many men were there at first?

3. Find the cube root of 11 to four places of decimals.

4. Frenchmen, on the average, consume yearly $1160^{g}$ of coffee and $9^{g}$ of tea; and Englishmen, $473^{g}$ of coffee and $1679^{g}$ of tea. If tea be $3s.$ and coffee $1s.\ 8d.$ per pound, and a franc be worth $10\frac{1}{2}\ d.$, find in francs the value of an Englishman's consumption above a Frenchman's.

5. Find the value of 2 pounds 5 ounces 8 dwts. 4 grains of silver at $\$125$ an ounce.

## 149.

1. Find the cost of 30 3-inch planks, 24 feet long and 11 inches wide, at $15 per M.

2. An agent sells 2200 barrels of flour at $4.50 a barrel, and charges 2½ per cent commission. He invests the proceeds in steel at 1½ cents a pound, charging 1½ per cent commission. What is his entire commission?

3. Two circular gold plates, each 1 inch thick and 6 and 8 inches in diameter respectively, are melted into one plate of the same thickness. Find the diameter of this plate, knowing that the area of a circle varies as the square of its diameter.

4. Find the cube root of 0.25 to four decimal places.

5. How many miles will be travelled in 1 hour 28 minutes 21 seconds at the rate of 50$^{km}$ an hour?

## 150.

1. An agent sells 1000 barrels of flour at $5.50 a barrel, and charges 2½ per cent commission; expenses for freight, etc., are $500. With the net proceeds he buys sugar at 6¼ cents a pound, charging 2½ per cent commission. How much sugar does he buy?

2. Find the number of feet board measure in 25 joists, each 6 inches by 4 inches, and 14 feet long.

3. Find the value of 3 pounds 8 ounces 16 dwts. 12 grains of gold at £3 17*s.* 10½ *d.* per ounce.

4. A pond whose area is 3 acres is frozen over with ice to the uniform thickness of 6 inches. If a cubic foot of ice weighs 896 ounces, find the weight of ice on the pond in long tons.

5. A jar full of water weighs 1.325$^{kg}$; filled with mercury, it weighs 12.540$^{kg}$. What is the capacity of the jar and its weight? The specific gravity of the mercury is 13.59.

# EXAMINATION PAPERS IN ARITHMETIC.

## I.

BOWDOIN COLLEGE, BRUNSWICK, ME.

*Examination for Admission, June*, 1883.

1. Find the difference between 0.0000005 and 0.00005.
2. Change 0.03125 to a common fraction in its lowest terms.
3. If the year is considered 365.25 days instead of 365.242264, how great will the error be in 1880 years?
4. The dividend is 7423.973, the quotient is 12.130, and the remainder is 0.413. What is the divisor?
5. What is the cost of 60.5 tons of coal when 0.9 of a ton cost $6.66?
6. Find the square root of 6.7081. Of 0.004 to the nearest ten thousandth. Of $\frac{49}{529}$.
7. Reduce 6453$^{m}$ to kilometers. 4.15$^{m}$ to centimeters. 6.45$^{l}$ to milliliters. How many decigrams does a dekaliter of pure water weigh?

## II.

DARTMOUTH COLLEGE, HANOVER, N.H.

*Entrance Examination, June*, 1883.

1. Find the G.C.D. of 66, 308, and 506.
2. Divide $\frac{3\frac{1}{2}}{7\frac{1}{2}}$ by $\frac{\frac{1}{2}+\frac{1}{6}}{\frac{1}{2}-\frac{1}{3}}$.

3. Give the value of the kilometer in feet; of the kiloliter in gallons; of the kilogram in pounds.

4. If there is a gain of $12\frac{1}{2}$ per cent on tea at 90 cents per pound, what would be the gain per cent at 84 cents per pound?

5. Find $\sqrt{\frac{1.23}{0.0625}}$ to four decimal places.

## III.

BROWN UNIVERSITY, PROVIDENCE, R.I.

*Examination for Admission, June*, 1883.

1. Reduce $\frac{1}{2}$ of 6 per cent of $1.05 \div \frac{3}{25}$ of $\frac{7}{10}$ to the simplest form.

2. If 17 men can reap a field in 9 days, how long would it take to reap half of it if 5 men refuse to work?

3. A man bought $200^{m}$ of cloth in France at $16\frac{1}{4}$ francs a meter; he paid $12\frac{1}{2}$ cents a yard for duty and freight, and sold it in Boston at $\$4.62\frac{1}{2}$ a yard. What was the gain? (1 franc = 19.3 cents.)

## IV.

MASS. INSTITUTE OF TECHNOLOGY, BOSTON, MASS.

*Entrance Examination, June*, 1882.

1. Find the L.C.M. of 105, 476, and 306.

2. A grocer makes a mixture of which 21.5 pounds contains $\frac{1}{2}$ pound of rye, 12 pounds of wheat, 5 pounds of oats, and 4 pounds of barley. How much of each ingredient will be contained in 100 pounds of the mixture?

3. Reduce to a decimal fraction $\frac{3\frac{1}{2}}{0.025}$, and from it subtract 0.01 of $\frac{1}{4}$.

4. In how many days will \$3245 gain \$80 at 7 per cent, simple interest?

5. Find the G.C.D. of 119 and 231.

6. Find the cube root of 0.012326391.

7. How many liters are contained in a cubical box 13 inches long, 13 inches wide, and 13 inches deep on the inside? (Given that $1^m = 39.37''$.)

8. How many grams of distilled water will such a box contain?

## V.

*Entrance Examination, Sept.*, 1882.

1. Reduce $\frac{3\frac{1}{3} - 2\frac{1}{5}}{9\frac{3}{7} + 5\frac{1}{4}}$ to its simplest form.

2. Reduce $\frac{7\frac{1}{2}}{\frac{1}{8}}$ to a decimal fraction.

3. A and B together have \$136, and $\frac{3}{5}$ of A's money is equal to $\frac{3}{4}$ of B's. How much has each?

4. At \$6.25 per ton, how many tons of coal can I buy for \$1000, and allow $2\frac{1}{2}$ per cent commission?

5. Find the square root of 0.00028562 to ten-thousandths.

6. Floor $10^m$ by $6.5^m$, carpet $90^{cm}$ wide; find cost of carpet at \$1.25 per meter.

7. In a parallelogram, given base $= 640^{dkm}$, altitude $= 180^{dkm}$; find area in hektars.

8. A cylindrical vessel $1^m$ high is made of sheet-iron $2^{cm}$ thick, and holds $100^l$. What is its outer diameter?

## VI.

### Harvard College, Cambridge, Mass.

*Examination for Admission, June*, 1883.

1. Find the difference between $3\frac{1}{4} \times 6\frac{1}{18}$ and $\frac{\frac{5}{6}+\frac{8}{9}}{7\frac{3}{4}}$.
2. A field is $38\frac{7}{50}$ rods long, and $37\frac{1}{2}$ rods wide. Find its area in acres and square rods. (Acre = 160 square rods.)
3. Find all the factors common to 1001 and 616.
4. The distance from Boston to Albany is 320$^{km}$. Find the distance in miles, assuming the meter to equal $3\frac{7}{25}$ feet.
5. A man, travelling 9 hours a day, goes 234 miles in 15 days. How far can he go in 30 days, travelling 8 hours a day?

## VII.

### Yale College, New Haven, Ct.

*Examination for Admission, June*, 1883.

1. Divide 82.1 by 41, 8.21 by 0.41, and 0.821 by 410. Carry the result in each case to four decimal places.
2. Find the value to three decimal places of
$$\sqrt{(0.146)^2+(0.063)^2}.$$
3. Divide $\frac{3\frac{3}{9}+\frac{6}{5}+\frac{1}{12}}{\frac{2}{3}\text{ of }5\frac{7}{8}} \times \frac{1}{\frac{4}{5}}$ by $\frac{133}{141}$.
4. Some sugar is adulterated as follows: $\frac{3}{10}$ is worth 8 cents per pound, $\frac{4}{9}$ is worth 10 cents per pound, $\frac{2}{15}$ is worth 12 cents per pound, and the remainder, 33 pounds, is sand. What is the mixture worth per pound?

5. Bank stock which sells at 170 pays an annual dividend of 12½ per cent. What rate of interest does a buyer receive?
6. Find the depth in meters of a cubical cistern which has a capacity of 30,000$^{l}$. Give the result to three decimal places.

## VIII.

SHEFFIELD SCIENTIFIC SCHOOL, NEW HAVEN, CT.

*Entrance Examination, June*, 1883.

1. Find the G.C.D. of 36,864 and 20,736.
2. Multiply $\frac{3}{4}$ of $\frac{8\frac{4}{5}}{6\frac{2}{5}}$ by $\frac{4}{9}$ of $\frac{\frac{2}{7}}{16}$.
3. (i.) Give the table of metric weights.
   (ii.) A cubical cistern holds 1331$^{kg}$ of water; what is the length of an inner edge?
4. Divide 67.56785 by 0.035, and multiply the result by $\frac{7}{8}$. Explain the position of the decimal point after division.
5. How much money should be received on a note of $1000, payable in 4 months, discounting at a bank where the interest is 6 per cent?
6. If a man travel 117 miles in 15 days, employing only 9 hours a day, how far would he go in 20 days, travelling 12 hours a day?
7. Extract the square root of 10 to five places.

## IX.

*Entrance Examination, Sept.*, 1883.

1. (i.) Select the prime numbers between 50 and 100.
   (ii.) What is the least number that can be exactly divided by $\frac{1}{15}$, $2\frac{1}{2}$, 5, $6\frac{1}{8}$, and $\frac{1}{11}$?

2. Reduce 0.00096 to its simplest equivalent common fraction.
3. 7465 is $33\frac{1}{3}$ per cent of what number?
4. A broker bought 84 shares of railroad stock at 19 per cent discount. He sold 35 shares at $27\frac{1}{2}$ per cent discount, and the balance at 8 per cent discount. Did he gain or lose, and how much?
5. Calculate the cube root of 3.7 to five decimal places.
6. Give the approximate value of the meter in feet; of the kilogram in pounds Avoirdupois.
7. Find the weight in kilos of 15 gallons of water.

## X.

### Amherst College, Amherst, Mass.

*Examination for Admission, June*, 1883.

1. From 10 take six millionths.
2. Divide 3.6412 by 400.
3. Reduce 0.0625 to a common fraction in its lowest terms.
4. Find the G.C.D. of 1235 and 1495.
5. How many rods of fence will be required to enclose 640 acres of land in a square form?
6. What is the difference in time between Boston and San Francisco, the longitude of the first being W. 71° 3′ 30″, and the second, W. 122° 24′ 40″?
7. Sold a pair oxen for $175, and gained 5 per cent; what per cent would I have gained if I had sold them for $200?
8. If 6 men in 15 days earn $135, how many dollars will 9 men earn in 18 days?
9. What is the weight of $27^{hl}$ of water?

## XI.

### WILLIAMS COLLEGE, WILLIAMSTOWN, MASS.

*Entrance Examination, June*, 1883.

1. Reduce $\frac{5}{7}$ to a decimal, and extract the square root to three places.
2. How long must the side of a square lot be to contain one acre of ground?
3. Find the interest on \$1385.50 for 23 days at 7 per cent.
4. Reduce $532^{km}$ to miles.

## XII.

### TUFTS COLLEGE, COLLEGE HILL, MASS.

*Examination for Admission, June*, 1881.

1. Find the L.C.M. of 108, 217, 54, 31.
2. Find the prime factors of 927, 342, 861. With these prime factors get the G.C.D of the given numbers.
3. Reduce the fraction $\dfrac{8\frac{1}{2} \times \frac{7}{13}}{\frac{1}{12} \text{ of } \frac{3\frac{1}{2}}{\frac{4}{5}}} \div \dfrac{\frac{1}{3}}{\frac{3}{4} \text{ of } \frac{7}{11}}$.
4. If the rate of discount is 5 per cent per annum, how much can be obtained on a note for \$600, payable in 4 months, discounted at a bank?
5. If from the retail price of a book 20 per cent is deducted, and a discount of 10 per cent is made on the balance, and then the book sells for \$1.33, what is the retail price?
6. What is the meter? Name its subdivisions. In $9780^{m}$ how many kilometers? Give the units of volume in the metric system; also, of weight.
7. What weight of mercury will a vessel contain whose capacity is $20^{ccm}$, the mercury being 13.5 times as heavy as water?

## XIII.

TRINITY COLLEGE, HARTFORD, CT.

*Examination for Admission, June*, 1883.

1. From the sum of $3\frac{3}{4}$ and $4\frac{5}{8}$ subtract $6\frac{9}{7}$, multiply the difference by $\frac{8}{9}$ of $\frac{27}{40}$ of 88, and find what fraction the product is of 999.
2. Find the amount of $342.42, from Feb. 5, 1879, to March 15, 1881, with interest at 7 per cent; and reduce it to pounds sterling?
3. What is the weight of water in a tank, if it would take 98 minutes to empty it, at the rate of 8.7[1] a minute? If it were filled with oil at $18.75 a hektoliter, what would the contents be worth?

## XIV.

WESLEYAN UNIVERSITY, MIDDLETOWN, CT.

*Examination for Admission, June*, 1883.

1. Express the value of $\dfrac{\frac{1}{2} - \left(\frac{1}{2\frac{2}{3}} \text{ of } \frac{3}{7\frac{1}{2}} \text{ of } \frac{5}{6}\right)}{32}$ exactly as a decimal.
2. What was the amount due January 15, 1883, on a note for $175, dated April 1, 1882, bearing $5\frac{1}{2}$ per cent interest?
3. A merchant sold $\frac{1}{2}$ of a certain lot of goods at a gain of 18 per cent, $\frac{1}{3}$ at a loss of 5 per cent, and the remainder at half cost. Did he lose or gain? What per cent?
4. Extract the square root of 0.01952, carrying the result to four places of decimals.

5. What is the cost of digging a cellar $3^{dkm}$ wide, $5^{dkm}$ $4^{m}$ long, and $2^{m}$ $6^{dcm}$ deep, at the rate of 50 cents a stere?

6. Two men undertake to do a piece of work for $6.00. One could do it alone in 5 days, the other in 8 days. With the assistance of a boy, they finish it in $2\frac{2}{3}$ days. How should the money be divided?

## XV.

### Cornell University, Ithaca, N.Y.

*Entrance Examination, June*, 1882.

1. Define: an abstract number, the prime factors of a number, a quotient, a mixed number, cube root, percentage, bank discount, compound interest.

2. Get the sum of five, five-tenths, thirty-seven thousandths, one-thousand millionths, XIX, MDCCCLXXXI, $0.\dot{1}\dot{8}$.

3. Find all the common divisors of 225, 2025, 8100.

4. Divide $\frac{4}{5}$ of 91 by $\frac{10}{27}$ of 637.

5. What is the amount, at compound interest, of $500 for 2 years 6 months, at 7 per cent?

6. Get the square root of 530 to three decimal places, and give the reasons for the several steps in the work.

7. Give the common and the metric tables for liquid measure?

8. How many liters in 10 gallons, 3 quarts, 1 pint, 3 gills, the gallon being 231 cubic inches, and the meter 39.37 inches?

## XVI.

STEVENS INSTITUTE OF TECHNOLOGY, HOBOKEN, N.J.

*Specimen Entrance Examination Paper.*

1. What is a prime number?
2. Find the L.C.M. of 36, 48, and 72. Why can it not be found by first dividing by 36?
3. Find the G.C.D. of 120, 228, and 720.
4. If John sells a book for 110 cents, and thereby loses 12 per cent, what did the book cost him?
5. Find the square root of 0.4 to three places.
6. Find the cube root of 0.8.
7. Multiply 3 hundredths by 300 thousandths.
8. Divide 300 thousandths by 3 hundred-thousandths.

## XVII.

MADISON UNIVERSITY, HAMILTON, N.Y.

*Entrance Examination, June*, 1882.

1. From $\dfrac{10.7+\dfrac{15.15}{2.1}}{3.21+\dfrac{3}{5}}$ subtract $\dfrac{5.85-4.002}{3\frac{1}{3}+\dfrac{9.72}{0.03}}$, obtaining the result to three places of decimals.
2. Extract the square root of 102.002 to two places of decimals.
3. What is the interest on \$1584 for 1 year, 2 months, and 20 days at 7 per cent?

## XVIII.

### VASSAR COLLEGE, POUGHKEEPSIE, N.Y.

*Specimen Examination Paper for Admission.*

1. Find the greatest common divisor of 256, 480, and 1296.

2. What is the value of $\left(\frac{8-.4}{2}+\frac{16-.8}{4}-\frac{5}{2}\right)\times 7\frac{7}{10}$?

3. What is the sum of $\frac{\frac{3}{5}\text{ of }\frac{5}{6}}{\frac{1}{2}}$ and $\frac{\frac{4}{7}\text{ of }\frac{7}{12}}{\frac{4}{5}\text{ of }2\frac{1}{4}}$?

4. Divide two thousand five hundred one and four-tenths by four thousand one hundred twenty-five ten-millionths. Divide 1.29136109 by 184.3, and write the quotient in words.

5. A gentleman bought a yacht for $3500, and sold it at a loss of 20 per cent; the buyer sold it at a gain of 25 per cent; what did the latter receive for it?

6. What sum of money, at 10 per cent compound interest, will amount to $8651.50 in three years?

7. A cistern is $4^{m}$ long, $24^{dm}$ wide, and $80^{cm}$ deep. How much water will it hold in cubic meters? In liters?

8. The longitude of St. Petersburg is 39° 19′ east; of New York 74° 41′ west; when it is one o'clock in the afternoon at St. Petersburg, what time is it at New York?

9. Extract the square root of 4.932841.

## XIX.

COLLEGE OF NEW JERSEY, PRINCETON, N. J.

*Examination for Admission, Sept.*, 1883.

1. Divide $\frac{0.6}{15}+\frac{7}{9}$ by $\frac{3.71}{630}$.

2. State and demonstrate a rule for finding the greatest common divisor of any set of integers; and make use of it to find the greatest common divisor of 847, 1331, and 1573.

3. Prove that any circulating decimal may be reduced to a rational fraction. To what fraction is the circulating decimal $0.\dot{5}\dot{7}$ equal?

4. Two bodies let fall at different instants from the same point are found, $\sqrt{\frac{5000}{981}}$ seconds after the latter of them started, to have fallen, the one $25^{m}$, the other $100^{m}$. These distances being to one another as the squares of the times during which the bodies have been falling, how many seconds must the one body have started before the other?

5. What per cent is 3 of 6? What is the number to which if 2 per cent of itself be added the sum is 516?

6. The amount of a certain principal at a certain rate of interest for 6 months is \$949.76, and for 1 year at the same rate is \$1003.52. Required the rate per cent and principal.

7. The dimensions of a room are, length $4^{m}\ 1^{dm}$, breadth $3^{m}\ 2^{cm}$, and height $3^{m}\ 1^{mm}$. Find its cubical contents (in kilosteres) and the area of its walls (in centares).

## XX.

JOHN C. GREEN SCHOOL OF SCIENCE, PRINCETON, N.J.

*Entrance Examination, Sept.*, 1883.

1. Simplify $\frac{2\frac{3}{4}+2\frac{7}{8}}{4\frac{3}{4}-3\frac{1}{7}}$.
2. Find the G.C.M. of 252, 315, 420, and 504.
3. Find the square root of 0.434 to three decimals.
4. If I sell goods at 4 per cent commission, and receive \$60, what amount have I sold?
5. Find the edge of a cubical can which will hold $27.57^{kg}$ of sulphuric acid, whose specific gravity is 1.8.

## XXI.

UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA, PA.

*Examination for Admission, June*, 1882.

1. Simplify $\frac{5\frac{5}{8}\div\frac{3}{8}}{1\frac{1}{2}\text{ of }\frac{5}{9}-10\frac{1}{3}}\times\frac{2}{5}\text{ of }\frac{1\frac{1}{2}\text{ of }4\frac{1}{3}}{13\frac{7}{8}\text{ of }5\frac{1}{3}}-\frac{1}{2}+\frac{3}{17}$.
2. Simplify $\frac{5\frac{1}{3}-0.042-2.4+7\frac{5}{6}}{16\frac{2}{15}\div 60\frac{1}{2}}$.
3. Simplify $0.\dot{6}\text{ of }3.3+\frac{1.75}{2.625}\text{ of }17+0.4\text{ of }5.75-\frac{1.\dot{7}14285}{2.0\dot{9}5238}$.
4. Extract the square root of 5683 to four places of decimals.
5. A rectangular piece of ground is $32^m\ 7^{dm}$ long, and $19^m\ 5^{cm}$ broad. Find the cost of enclosing it with a path $1^m\ 5^{dm}$ broad, at 3 francs 5 centimes a square meter. (i.) Path outside of the ground; (ii.) path part of ground.
6. A house cost \$5000, and rents for \$25 a month, with \$25 to pay annually for repairs and \$50 for taxes; what is the difference in the income from this and from the same money invested in 6 per cent stock at 96?

## XXII.

UNIVERSITY OF MICHIGAN, ANN ARBOR, MICH.

*Examination for Admission, June*, 1883.

1. Reduce $\frac{2\frac{1}{3}+5\frac{1}{2}}{\frac{7}{6}}$ to a simple fraction, and state the process and principles.
2. Reduce 2 years 5 months 12 days to years and decimals of a year.
3. Extract the square root of 0.4.
4. Give the denominations used in linear measure in the metric system.
5. How are the measures of capacity and of weight in the metric system related to the linear measures?

## XXIII.

LAKE FOREST UNIVERSITY, LAKE FOREST, ILL.

*Entrance Examination, June*, 1882.

1. Add ten thousand and one millionth; four hundred thousandths; ninety-six hundredths; forty-seven millions sixty thousand and eight billionths.
2. Define integer, compound number, the power of a number, a fraction. How many classes of fractions?
3. Find the interest of $375.75 for 4 years 5 months and 25 days, at $4\frac{1}{2}$ per cent.
4. If the wages of 72 men for 5 days is $450, how many men may be hired for 12 days for $540?
5. A can build a wall in $18\frac{3}{4}$ days, B in $31\frac{1}{4}$ days; how long will it take both together to build it?

6. What is the present worth of $3471.50, due 3 months and 9 days hence, at 7 per cent?

7. What is the interest at 4½ per cent of $360.45, from July 4, 1873, to November 3, 1875, allowing a credit of $75, paid October 5, 1874?

8. Reduce to equivalent fractions, having a common denominator, $\frac{3}{5}$ of $\frac{2}{7}$, $2\frac{3}{5}$, $5\frac{2}{3}$, $\frac{3}{5}$ of $\frac{1}{3}$ of $3\frac{1}{2}$.

9. On what principal at 7 per cent, in 1 year and 3 months, will the interest be $15.40?

10. Extract the cube root of 225,866,529.

## XXIV.

EDUCATION DEPARTMENT, ONTARIO.

*Examination for Admission to High Schools, June*, 1883.

1. What is the object of division? Write down the relation connecting the divisor, dividend, quotient, and remainder.

   Divide one hundred and eight billion four hundred and nineteen million seven hundred and sixteen thousand and one, by eighteen million seven hundred and forty-eight thousand and five.

2. Find, by "casting out nines," whether the following is correct: 349,751 × 28,637 = 10,015,819,397.

   Find the weight of 500,000 bricks at 4 pounds, 2 ounces each, and the cost, in dollars and cents, at 27*s.* 6*d.* a thousand, allowing 4*s.* 2*d.* to make a dollar.

3. A merchant received from England the following invoice in sterling:

375 tons iron plates, at £8 15*s.* 6*d.*; 107½ tons bar iron, at £11 14*s.*; 10 tons bulb iron, at £10 10*s.*; 17 tons T iron, at £15 10*s.*; 48 tons steel, at £18 7*s.* 6*d.*; 15 tons rivets, at £11 1*s.* Find the amount of this invoice in Canadian currency, allowing the shilling sterling to be equal to 24⅓ cents.

4. At $1.75 per rod, what will it cost to fence a piece of land 63.5 rods long, and 27.75 rods wide?

5. Simplify $1 - \frac{1}{6} + \frac{1}{24} - \frac{61}{5040} + \frac{277}{72576} = \frac{314513}{362880}$; and $\dfrac{4\frac{7}{10} + 5.\dot{8}\dot{1} - 2.5}{4\frac{7}{10} \text{ of } 32 \text{ of } 0.\dot{4}\dot{5}} = \dfrac{441}{3760}$.

6. Gunpowder is composed of nitre, charcoal, and sulphur, in the proportion of 15, 3, and 2. A certain quantity of gunpowder is known to contain 20 cwt. of charcoal; find its weight, and also the weight of nitre and of sulphur it contains.

7. Bought 360 gallons of wine at $2.60 a gallon; paid for carriage, $17.20, and for duties, $86.50. If $\frac{3}{20}$ of it be lost by leakage, at what price must the remainder be sold to gain $50 on the whole transaction?

8. Find the interest on a note for $257.81, dated January 3, 1883, and paid April 6, 1883, at 8 per cent per annum.

9. The length of a second's pendulum is 39.37079 inches; if 64 French meters are equal to 70 yards, by what decimal of an inch will the length of a second's pendulum differ from one meter?

10. At what times between 4 and 5 o'clock are the hands of a clock (i.) coincident? (ii.) at right angles?

## XXV.

EDUCATION DEPARTMENT, ONTARIO.

*Examination of Third Class Teachers, July*, 1883.

1. Add together $\frac{4}{7}$ of £13, $\frac{1}{8}$ of $\frac{1}{2\frac{4}{5}}$ of $\frac{5}{6}$ of £2 12*s.*, and $\frac{5}{7}$ of 9*d.*

   Reduce 13*s.* 4½ *d.* to the decimal of 19*s.* 6*d.*

2. Find by practice the value of 8596 pounds, at £10 18*s.* 7½*d.* each.

3. A person borrows $500 on April 10, and on June 22 pays his debt with $510.20. At what rate per cent per annum was he charged interest?

4. A man having a certain sum of money to invest has an opportunity of purchasing 7 per cent stock at 95, but delays until it has risen to 110. What per cent is his income less than if he had purchased at the first price?

5. At an international exhibition, one country was awarded 5 gold, 9 silver, and 11 bronze medals; and another, 4 gold, 15 silver, and 10 bronze. Find a ratio of values for such medals that these countries may be regarded as equally fortunate.

6. In a box there is a certain number of sovereigns, three times as many guineas, and twice as many marks (13*s.* 4*d.*) as guineas. The entire amount in the box is £815. How many coins of each kind are there?

7. Find when first after 2 o'clock the hour and minute hands of a clock make an angle of 60 degrees with each other.

8. For each of three succeeding months the population of a north-west town rose 50 per cent; and at the end of the third month was 2700. What was the population at the beginning of the time?

9. Leap year is omitted once in every century, except those centuries whose number is divisible by 4. What is the average length of a year?

10. A cube is formed of a certain number of pounds Avoirdupois of a substance, and the same number of pounds Troy of the same substance. What proportion will a side of the cube bear to a side of a cube formed of the same number of pounds as before, but all Avoirdupois? (175 pounds Troy = 144 pounds Avoirdupois.)

## XXVI.

### Education Department, Ontario.

*Examination of Second Class Teachers, July*, 1883.

1. Prove that $\frac{1}{4}$ of $\frac{3}{7} = \frac{3}{2\,8}$.
Simplify $(2\frac{2}{7}$ of $3\frac{1}{16}) + \frac{4}{8} - (1\frac{1}{8}$ of $1\frac{5}{16}) - (1\frac{3}{4}$ of $4\frac{4}{7}$ of $\frac{8}{14})$.

2. The pendulum of one clock makes 24 beats in 26 seconds; that of another, 36 beats in 40 seconds. If they start at the same time, when first will the beats occur together?

3. A can do as much work in 4 hours as B in 6; and B in $3\frac{1}{2}$ as C in 5. A does half a certain piece of work in 12 hours; in what time can it be finished by B and C, working separately equal times, and C succeeding B?

4. A note for $500, made March 9, at 3 months, is discounted April 11, at 8 per cent. What is received for the note? (True discount.)

5. The unclaimed dividends on a certain amount of stock which pays 6 per cent per annum amounted in 3 years to $1152. The stock was sold at a discount of 12½ per cent on its par value. What sum was realized?

6. Teas at 3*s.* 6*d.*, 4*s.*, and 6*s.* a pound, are mixed to produce a tea worth 5*s.* a pound. What is the least integral number of pounds that the mixture can contain?

7. A man buys 150 pounds of sugar, and, after selling 100 pounds, finds he has been parting with it at a loss of 5 per cent. At what rate per cent advance on the cost must he sell the remaining 50 pounds that he may gain 10 per cent on the entire transaction?

8. Each member of a pedestrian club walks as many miles as there are members in the club, and the expense of the trip is for each member as many pence per mile as there are members in the club. The total expense is £50 13*s.* 11*d.* How many members are there?

9. The hour, minute, and second hands of a watch are on concentric axes. When first after 12 o'clock will the direction of the second hand, produced backwards, bisect the angle between the hour and the minute hands?

## XXVII.

EDUCATION DEPARTMENT, ONTARIO.

*Examination of Third and Second Class Teachers, July*, 1883.—*Mental Arithmetic.*

1. A hall-way is 90 inches wide, and takes 25 square yards of oil-cloth to cover it. How long is it?

2. A gentleman travels from Toronto to Montreal and back. He goes at an average rate of 33 miles per hour, and returns at an average of 30 miles per hour, and he finds that he occupied one hour longer in returning than in going. Find the distance from Toronto to Montreal.

3. A can do a piece of work in 7 days, and B can do it in 8 days. A works at it for $2\frac{1}{2}$ days, and B works at it for 3 days. C then finishes it in $3\frac{3}{4}$ days. In how many days could C have done the whole work alone?

4. By selling an article for $21 I would lose $12\frac{1}{2}$ per cent. At what should I sell it in order to gain $12\frac{1}{2}$ per cent?

5. A merchant marked his goods at an advance of 60 per cent on cost. He gave one of his customers a discount of 15 per cent off the marked price. What was his gain on $6.80 received from that customer?

6. How much stock must I sell out of the $3\frac{1}{2}$ per cents, at 84, to enable me to buy $7700 4 per cent stock, the value of the stock being proportional to the dividends they pay?

## XXVIII.

EDUCATION DEPARTMENT, ONTARIO.

*Examination of First Class Teachers, July*, 1883.

1. Define a recurring decimal, and classify the several kinds.

   Prove, in any way, a rule for converting a mixed circulating decimal into its equivalent vulgar fraction, and apply your rule to convert $0.1013\dot{2}\dot{5}\dot{7}$.

2. Perform the operations here indicated, employing contracted multiplication and division, and retaining 6 decimals throughout: $\frac{0.3372+0.03172}{6146.38} \div 0.0004675$.

3. In the expression, "6 per cents are at 103," explain fully what is meant.

   A person sells a certain amount of 5 per cents for 86, and invests in the 6 per cents at 103, and by so doing changes his income by one dollar. Is the change an increase or decrease? How much stock does he sell?

4. A man buys a note, drawn for 2 years at 6 per cent interest, and which is now 6 months old, at 15 per cent true discount. After keeping it 9 months, and receiving one payment of interest, he sells it to a bank at 8 per cent bank discount. What per cent does he make upon his money while invested?

5. A, B, and C, whose rates of walking are $3\frac{1}{2}$, 4, and 5 miles an hour, respectively, walk on circular tracks whose circumferences are 8, 10, and 15 miles, respectively, and whose centres are in the same straight line. At the same instant they start from points on this line, and on the same side of the centres. Find (i.) when first they will be all on this line at the same time; (ii.) all at same time at the points from which they started; (iii.) whether they will ever be all at the same instant at points on opposite sides of the circles to the starting points.

6. Lead is 11.4 times, and zinc 7.2 times, as heavy as water. If 3 pounds of lead and 2 pounds of zinc be melted together, compare the weight of the alloy with that of water.

7. A, B, and C start at the same time and from the same point, to travel around an island 26 miles in circuit. A goes 10 miles and B 4 miles per hour in the same direction, and C goes 5 miles per hour in the opposite direction. When and where will they first be all together again?

Algebraical symbols will be allowed in the three following questions:

8. It is required to make a hollow leaden cylinder, open at both ends, 10 inches long, with its wall 1 inch thick, and which is to weigh 25 pounds. Find its outside diameter.

9. A conical vessel, 6 inches deep and 3 inches across the mouth, is filled to 5 inches with water. Find the diameter of the sphere which, when dropped into the cylinder, will raise the water so as just to fill the vessel.

10. The diagonals of a quadrilateral plane figure are 10 and 12, and they intersect at an angle of 60°. Find the area of the figure.

## XXIX.

COLLEGE OF OTTAWA, OTTAWA, CAN.

*Matriculation Examination. Session* 1881–82.

1. What is the exact value of $\left(2\frac{3}{4} + \frac{5}{2} \text{ of } \frac{7}{2\frac{4}{5}} + \frac{4\frac{4}{9}}{1\frac{1}{3}}\right) \div 4\frac{85}{228}$?

2. The sum of two numbers is 240; their L.C.M. is 1728. What are the numbers?

3. Define *discount*, and find the discount on a bill of £10, due at the end of a year, at 10 per cent.

4. Find the simple interest of $442, at 4 per cent, for 5 years; and the compound interest of $500, at 3 per cent, for 2 years.

5. The sea covers $\frac{11}{14}$ of the surface of the globe. The area of Asia is $\frac{121}{27}$ of that of Europe, whilst the area of Africa is $\frac{22}{7}$; the area of America is $\frac{111}{27}$; and the area of Oceania is $\frac{8}{27}$. Africa having an area of 11,630,400 square miles, find the area of all the other parts, and that of the entire globe.

6. Prove that the product of $n(n+1)(2n+1)$ is always divisible by 6, whatever be the whole number $n$.

## XXX.

COLLEGE OF OTTAWA, OTTAWA, CAN.

*Matriculation Examination. Session* 1882–83.

1. A man has 3 farms of 56, 72, and 88 acres, respectively, and wishes to fence them into the largest possible fields, having each the same number of acres. How many acres did he put in each?

2. A grocer has a 4-pound, 5-pound, 6-pound, and a 12-pound weight. What is the smallest tub of butter that he can weigh by each without a remainder?

3. A man owning $\frac{11}{16}$ of a ship worth $48,064 sold $\frac{1}{4}$ of his share. What part of the ship did he sell? What part does he still own? and what is this part worth?

4. What is the worth of a silver cup weighing 10 ounces 16 dwt., at $12\frac{1}{2}$ cents a pennyweight?

5. The longitude of Ottawa is 75° 43′ 22″ W. of Greenwich; the longitude of Washington is 77° 3′ 1″. What is the difference in time between Ottawa and Washington?

6. A lad at the age of 14 received a legacy of $5000; he then lent it at 8 per cent simple interest. What is his legacy worth when he is 21?

7. Two men hire a pasture for $50; one put in 20 horses for 12 weeks, the other 25 horses for 10 weeks. How much should each pay?

8. A milkman bought 40 gallons of new milk, at 16 cents a gallon, and 60 gallons of skimmed milk, at 8 cents a gallon, which he mixed with 12 gallons of water, and sold the whole at 24 cents a gallon. What was his profit?

9. Simplify $\frac{3\frac{7}{9} \times 1\frac{1}{17} + 8\frac{1}{12} - 3\frac{9}{16}}{5\frac{1}{9} - 7\frac{7}{8} \div 28\frac{7}{20} + \frac{1}{8}}$, $\frac{3\frac{2}{3}}{4\frac{1}{7}} \times (3\frac{5}{8} \times 5\frac{6}{7}) - 17\frac{3}{8}$, and find their sum.

## XXXI.

McGILL UNIVERSITY, MONTREAL, CAN.

*School Examination, June*, 1883.

1. What is the meaning of *numeration? notation? addition? subtraction? multiplication? division?* Divide three hundred sixty millions nine hundred nineteen thousand eight hundred fifty-six by eighty-three.

2. What letters are used in Roman notation, and how are they combined to express numbers? Change 9909 into Roman notation.

3. What is the difference between a vulgar and a decimal fraction? Convert $\frac{17}{1375}$ into a decimal.

4. Multiply $2.60\dot{4}$ by $1.2\dot{3}\dot{4}$, and divide the result by $0.00\dot{4}$.

5. Find the value of 21 acres 3 roods 12 poles, at $45 per acre.

6. Find the L.C.M. of 3, 5, 9, 12, 17, and 20; and the G.C.M. of 441 and 693.

7. Calculate the simple interest on $580 from May 16, 1882, to October 8, 1883 (both days inclusive), at 5 per cent per annum.

8. If the wages of 12 men for 8 days of 8 hours each be $135, what will be the wages of 25 men for 12 days of 10 hours each?

9. Find the cost of planting a rectangular field measuring 34 poles 2 yards by 26 poles 3 yards, at $6.50 per square pole, leaving a path 4 feet wide all round the field.

10. If 25 pounds of tea, at 60 cents per pound, be mixed with 30 pounds, at 47 cents, find the price of the mixture per pound in order that there may be a profit of 18 per cent.

11. If a house had been sold for $7992, there would have been a gain of 8 per cent on outlay. How much per cent is lost or gained by selling it for $7511?

12. Find the distance between the opposite corners of a rectangular floor which measures 8 feet 3 inches by 12 feet 6¼ inches.

## XXXII.

UNIVERSITY OF CAMBRIDGE, ENG.

*Second Previous Examination, Dec.*, 1880. — *Time allowed*, 2½ *hours.*

1. Find the G.C.M. of 2301 and 3717, and the L.C.M. of 192, 204, and 272.

2. Divide $3\frac{3}{14} - 4\frac{7}{8} + 1\frac{19}{24}$ by $1\frac{3}{8} + 5\frac{17}{21} - 7\frac{1}{24}$.

3. A kiloliter contains 35.32 cubic feet, and a gallon contains 277.274 cubic inches; how many gallons are there in a kiloliter?

4. Add together $\frac{3}{5}$ of a guinea and a half, 0.855 of a pound, and $1\frac{1}{7}$ of $2\frac{3}{7}$ of $1\frac{3}{4}$ of 18*s.* $4\frac{1}{2}d.$

5. Extract to three places of decimals the square roots of 6 and $0.2\dot{8}\dot{7}$.

6. Find as recurring decimals the square of $0.\dot{4}$, and the square root of $0.69\dot{4}$.

7. Calculate the cost of paper for a room 18 feet long, 16 feet broad, and 12 feet high, allowing 40 square feet for doors and windows, the price of the paper being 2*s.* 4*d.* per piece of 12 yards long and 21 inches broad.

8. A Cambridge Poor Rate, at 11*d.* in the pound, is made up of the Union Contribution, $5\frac{1}{2}d.$; the Borough Rate, 4*d.*; the Asylum, etc., $1\frac{1}{2}d.$ The rate on a certain property amounts to £100 8*s.* 5*d.*; how much of this is for the Borough Rate, and at what amount is the property assessed?

9. Find the difference between the amount of £1205, put out for 2 years at 5 per cent compound interest, and the present value of the same sum due 2 years hence at 5 per cent compound interest.

10. The 11.45 Exeter express from Paddington stops first at Swinden, $77\frac{1}{2}$ miles distant, at 1.12. In the whole journey, 194 miles, 15 per cent of the time is expended in stoppage, etc. At what time is the train due at Exeter?

11. What income would be derived from investing £9350 in $5\frac{1}{2}$ per cent preference stock at $137\frac{1}{2}$?

## XXXIII.

### UNIVERSITY OF CAMBRIDGE, ENG.

*Previous Examination, June,* 1881. — *Time allowed,* 2½ *hours.*

1. Arrange in order of magnitude the fractions $\frac{3}{5}$, $\frac{8}{10}$, $\frac{7}{15}$, and $\frac{9}{19}$; and find the difference between the greatest and least.

2. Simplify $\frac{\frac{1}{2}-\frac{1}{3}}{\frac{1}{2}+\frac{1}{3}}$ of $\frac{\frac{1}{4}-\frac{1}{5}}{\frac{1}{4}+\frac{1}{5}}$ of $\frac{\frac{1}{6}-\frac{1}{7}}{\frac{1}{6}+\frac{1}{7}}$ of 585.

3. Find a decimal which shall differ from $\frac{17}{21}$ by less than $\frac{1}{10000}$.

   Simplify $\frac{1.875}{2.1} \times \frac{3.5}{3.75}$.

   Find the sum of
   $2.\dot{4}$, $0.3\dot{2}$, $0.5\dot{6}7$, $7.05\dot{6}$, $4.1\dot{7}$, and $0.\dot{4}304122\dot{2}$.

4. Calculate the value of $\sqrt{3+2\sqrt{2}}$ correctly to two places of decimals.

5. Find by practice the value of a nugget of gold weighing 3 pounds 11 ounces 18 pennyweights 4 grains at £3 17*s.* 6*d.* per ounce.

6. A lawn-tennis ground is half as long again as it is wide. The cost of levelling at 9*d.* per square yard is £176 8*s.* 0*d.* Find the cost of enclosing it with an iron railing at 7*s.* 6*d.* per yard.

7. A sum of £650 is due from A to B on a certain day, and £495 12*s.* 6*d.* is also due 7 months later. Show that, reckoning interest at 5 per cent, if A pay both debts at the end of 3 months, neither of them will lose.

8. Brussels carpet is 2 feet wide, costs 6*s.* 6*d.* a yard, and will last 5 years. Kidderminster carpet is $2\frac{1}{2}$ feet wide, costs 5*s.* a yard, and will last 3 years. Which is the cheapest, not reckoning interest on your outlay?

9. Two men and three boys can level and turf 352 yards of a cricket-ground in 4 days; and three men and two boys can complete 276 yards in 3 days. Compare the rates of working of a man and a boy.

10. A man has £7220 stock in the 3 per cent consols. When they are at $102\frac{5}{8}$ he sells, and invests in the $2\frac{1}{2}$ per cents at $90\frac{1}{8}$. Find the change in his income. (Brokerage is $\frac{1}{8}$ per cent.)

11. A steel rod, 1 foot long and 1 inch square, weighs $3\frac{1}{2}$ pounds, and will just support 50 tons. What is the greatest length of steel wire which, when hung up by one end, will just not break by its own weight?

## XXXIV.

### University of Cambridge, Eng.

*Second Previous Examination, Dec.*, 1881. — *Time allowed*, $2\frac{1}{2}$ *hours.*

1. Simplify $\dfrac{3\frac{1}{4} \text{ of } 4\frac{1}{3}}{(2\frac{1}{2} - \frac{1}{3}) \text{ of } (3\frac{1}{2} - \frac{1}{4})}$.

2. Find the difference between $\frac{5}{9}$ of 31 acres 2 roods 27 poles, and $\frac{7}{8}$ of 18 acres 1 rood 0 poles.

3. Reduce 5 days 16 hours to the decimal of a week.

Find the value of $\dfrac{0.321 \times 0.321 - 0.179 \times 0.179}{0.321 - 0.179}$ of £5.

4. Find the square roots of $27\frac{1}{25}$ and 90,018.0009.
   A Christmas dole is given to the inhabitants of certain almshouses, consisting of as many shillings to each as there are inhabitants. The sum so expended is £9 16*s.* 0*d.* How many inhabitants are there?

5. At what rate per cent will the simple interest on £236 6*s.* 8*d.* amount to £17 14*s.* 6*d.* in $2\frac{1}{2}$ years?

6. Find the present worth of £1250 0*s.* $2\frac{1}{2}d.$ due 7 months hence at $3\frac{1}{2}$ per cent.

7. What sum of money must be invested in $4\frac{1}{2}$ per cent stock at $83\frac{7}{8}$ to bring in an income of £219? (Brokerage is $\frac{1}{8}$ per cent.)

8. A man walking 18 miles finds that in 1 hour 40 minutes the distance he has walked is $\frac{5}{7}$ of the remaining distance. Find his rate of walking.

9. A cubical cistern, open at the top, costs 15 guineas to line with lead at 1*s.* 9*d.* per square foot. How many cubic feet will it contain?

10. A man's income is increased by £200; but the income tax being reduced from 6*d.* to 5*d.* in the pound, he pays the same amount of tax as before. What is his income?

## XXXV.

### UNIVERSITY OF CAMBRIDGE, ENG.

*Previous Examination, June,* 1882. — *Time allowed,* $2\frac{1}{2}$ *hours.*

1. Reduce $\frac{4483}{8125}$ to a decimal, and $2.48\dot{0}2\dot{7}$ to a vulgar fraction in its lowest terms.

2. Simplify $5\frac{1}{3}$ of $\dfrac{1}{1\frac{1}{3}+\dfrac{1}{2\frac{1}{4}}} \div \dfrac{4\frac{1}{5}+5\frac{1}{4}}{4\frac{1}{4}+3\frac{2}{3}}$.

3. Find the cost of 7 cwt. 2 quarters 23 pounds at £11 1*s.* 8*d.* per cwt.

4. A man who has sold tea at half-a-crown per pound, making a profit of 25 per cent, lowers his price so as to gain only 2*d.* per pound. In what ratio must his weekly sale increase that he may make twice as much as before?

5. Find the amount of £325 16*s.* 8*d.* in $3\frac{1}{2}$ years at $4\frac{1}{4}$ per cent simple interest.

6. If a bill of £932 2*s.*, due Dec. 19, be paid June 6, find the true discount to be allowed, reckoning interest at 4 per cent per annum.

7. The amount of sunshine recorded in Jersey last year, in the month of April, was 33 per cent of the possible amount; and the average length of the night in that month is 10 hours 30 minutes. Find how many hours of sunshine there were in the month.

8. The length of a side of the base of the Great Pyramid, which is square, is 500 Egyptian cubits:
   (i.) Find the area covered by it in acres, roods, etc., knowing that an Egyptian cubit is equal to 18.24 English inches.
   (ii.) Find the height of the Pyramid in cubits, having given that the height of a model of the Pyramid, the area of whose base is 8 square feet 73 square inches, is 22.225 inches.

9. Which is the more profitable stock to invest in, 3 per cent at $83\frac{1}{2}$, or $3\frac{1}{2}$ per cent at 97?

10. Two men undertake to do a piece of work for 1 guinea. One could do it alone in 6 days, the other in 7 days. With the assistance of a boy they finish it in 3 days. How should the money be divided?

## XXXVI.

### University of Oxford, Eng.

*Local Examination, Junior Candidates, May, 1881.*
*Time allowed, 2 hours.*

Every candidate is required to satisfy the examiners in the first part of this paper. The second part is intended for those candidates *only* who offer mathematics as a subject, and is not to be attempted by any until they have done all they can do of the first part. Attention should be paid to spelling and hand-writing. No credit will be given for any answer, the full working of which is not shown.

### I.

1. Express in words 90,999,090,009; and in figures, two thousand millions four hundred thousand and sixty.
2. Multiply 810,901 by 809,101; and 1 ton 0 cwt. 0 quarters 5 pounds by 449.
3. Divide 25,600,160,001 by 159,601; and £183 12*s.* 1½*d.* by 58.
4. A field containing 18 acres 36 poles is divided into allotments, each containing 1 rood 14 poles. How many of them are there?
5. Reduce 28 quarters 5 bushels 1 peck 1 gallon to pints.
6. Simplify $\frac{3\frac{1}{7} - \frac{2}{3}}{\frac{4}{49} \times 7\frac{7}{12}}$; and divide 0.00036 by 0.006.
7. Express 2 yards 3 inches as the fraction of 1 mile 30 perches.
8. If it cost £9 5*s.* 4*d.* to carpet a room whose floor contains 278 square feet, how many square feet are there in one which can be carpeted for £12 4*s.* 8*d.*?

II.

9. Find the simple interest on £11,000 for 4.4 years at 3.15 per cent.

10. The external length, breadth, and depth of a box are 6 feet 2 inches, 3 feet 8 inches, and 2 feet, respectively, and it is made of wood 1 inch thick. Find the quantity used.

11. Two pipes running together can fill a cistern in 8 minutes, and one of them alone can fill it in 24 minutes. How long would the other alone take?

12. If 12 men, working 8 hours a day, do $\frac{4}{5}$ of a piece of work in 20 days, how many days will 15 men, working 10 hours a day, take to do $\frac{7}{8}$ of it?

## XXXVII.

UNIVERSITY OF OXFORD, ENG.

*Local Examination, Senior Candidates, May*, 1881. — *Time allowed*, 2 *hours*.

No credit will be given for any answer, the full working of which is not shown.

1. How many times is £27 15*s*. 7$\frac{3}{4}$*d*. contained in £1356 6*s*. 9*d*.? and how much remains over?

2. Multiply 1 acre 3 roods 7 poles 4 yards by 17.

3. Add together $3\frac{5}{14}$, $5\frac{4}{21}$, $\frac{11}{24}$, and $1\frac{1}{8}$ of $\frac{5}{56}$.

4. In a row of 25 houses, each house has 17 windows, each window 4 panes, and each pane measures 18 inches by 9 inches. What will be the cost of glazing all these windows at 6*d*. per square foot?

5. Multiply 47.625 by 0.128; divide 1.05 by 0.875; and find the value of $\frac{(1.005+0.201)\times(1.005-0.201)}{1.005\times 0.201}$.

6. Reduce £5 17*s.* 7½*d.* to the decimal of £100; and find the value of $0.70\dot{9}$ of 5 tons 3 cwts. 14 pounds.

7. Find the cost of 227 tons 15 cwts. 21 pounds at £12 13*s.* 4*d.* per ton.

8. Extract the square root of 36,180,225 and of 0.000144.

9. Find the simple interest and amount of £225 13*s.* 4*d.* for 2½ years at 4¾ per cent per annum.

10. If the value of 47 pounds 1 ounce of silver be £184 16*s.* ½*d.*, what is the value of 84 pounds 9 ounces?

11. If 27 men mow a field of 90 acres in 7 days, working 8 hours a day, how many men will be required to mow 200 acres in 16 days, if they will work 10 hours a day?

## XXXVIII.

### University of Oxford, Eng.

*Local Examination, Junior Candidates, June, 1882. — Time allowed, 2 hours.*

Every candidate is required to satisfy the examiners in the first part of this paper. The second part is to be attempted by those candidates *only* who offer mathematics as a subject. Attention should be paid to spelling and handwriting. No credit will be given for any answer, the full working of which is not shown.

I.

1. Add together seventeen hundred and seventy, a hundred and seventy thousand and seventy, and seventeen million eight hundred and twenty-nine thousand; and express the result in words.

2. Multiply 302,050 by 702,090; and 4 days 22 hours 33 minutes 49 seconds by 401.

3. Out of a salary of 25 guineas per quarter, how much will be saved in a year, when the expenditure is at the rate of 5*s.* 3*d.* per day?

4. Divide 40,301 acres 0 roods 38 rods 9 yards by 251.

5. Find the number of quarters, bushels, etc., in 2559 pints.

6. Find the value of
$(\frac{7}{55}$ of $1\frac{1}{10}) \div (\frac{5}{88}$ of $\frac{2}{11})$; and of $\frac{2}{45}$ cwt. $+ \frac{3}{7}$ pound.

7. Divide 4.00004 by 0.0011; and reduce $0.00\dot{1}2\dot{6}$ to a vulgar fraction.

8. If $6\frac{1}{4}$ tons of coal cost £6 15*s.* 5*d.*, what will be the price of 5 tons 3 cwts.?

## II.

9. If 5 men and 9 boys could do a piece of work in 17 days, in how many days would 9 men and 12 boys do it, the work of 2 men being equal to that of 3 boys?

10. Find the simple interest on £2970 16*s.* 8*d.* for 3 years 73 days at £3 2*s.* 6*d.* per cent.

11. A man buys goods which he sells again for £11 18*s.* $\frac{1}{2}$*d.*, making a profit of 16 per cent; what is the buying price?

12. Pipes A and B can fill a cistern in 3 minutes and 5 minutes, respectively, and C can empty it in $7\frac{1}{2}$ minutes. In what time will the cistern be filled when A, B, and C are all open?

## XXXIX.

UNIVERSITY OF OXFORD, ENG.

*Local Examination, Senior Candidates, June, 1882. — Time allowed, 2 hours.*

No credit will be given for any answer, the full working of which is not shown.

1. Reduce 121 quarters 1 bushel 1 peck to quarts.
2. Into how many allotments, each containing 2 roods 10 perches, can a rectangular field 450 yards long and 121 yards be divided?
3. Reduce to their simplest forms the fractional expressions,
$$\frac{\frac{1}{2}+\frac{1}{3}-\frac{1}{6}}{\frac{1}{2}\text{ of }\frac{1}{3}\text{ of }\frac{1}{6}}, \quad 1-\frac{2}{3+\frac{3}{5-\frac{6}{7}}}.$$
4. Square 109.901 and $0.\dot{2}\dot{3}$.
5. Extract the square root of 35,445.5929.
6. Reduce $\frac{3}{5}\frac{1}{7}$ of £2 2*s.* 9*d.* to the vulgar fraction of £2 2*s.* $7\frac{1}{2}$*d.*; and express in money 0.334375 of £5.
7. Find the weight of a quantity of metal worth £2 2*s.* 9*d.*, having given that 2 tons 8 cwts. 3 quarters 12 pounds is worth £1.
8. How much is gained or lost per cent by buying a number of oranges at 5 for twopence, and selling half of them at two a penny and half at three a penny?
9. Find the simple interest on £7446 12*s.* $2\frac{2}{3}$*d.* for $1\frac{3}{4}$ years at $4\frac{2}{7}$ per cent.
10. During 365 days 6 hours the earth makes $366\frac{1}{4}$ revolutions about its axis. How long will it take in making 879 revolutions?

11. If 3 men can reap 8 acres in 5 days, working 8 hours a day, in how many days can 8 men, working 12 hours a day, reap 192 acres?

## XL.

### University of Oxford, Eng.

*First Examination of Women, May*, 1880.— *Time Allowed*, 2 *hours.*

1. Forty-five telegraph posts, placed at equal distances, extend a mile; how far apart are the posts?
2. How many articles at £3 7*s.* 6*d.* each are worth as much as 324 articles at £1 12*s.* 6*d.* each?
3. Simplify $\frac{2597}{3445} + \frac{1\frac{3}{5}}{6\frac{1}{2}}$.
4. Divide 25.6 by 16, 2.56 by 0.16, and $0.\dot{0}\dot{9}$ by $0.0\dot{4}$.
5. Find the value of
   $\frac{4}{17}$ yard + $\frac{42}{2047}$ pole + $\frac{1}{1452}$ rood + $\frac{2}{80855}$ acre;
   also of 0.00008544921875 of a ton, and $0.1805\dot{}$ of a guinea.
6. If 12 men or 15 women do a piece of work in 252 days, in what time can 11 men and 2 women do the same piece of work?
7. Find the cost of papering a room 11 yards 2 feet 4 inches long, 6 yards 2 feet wide, 5 yards 2 feet 6 inches high, with paper 1 yard 4 inches wide, at 3*d.* a yard.
8. Sugar is bought at $1\frac{1}{4}$*d.* a pound, and sold at £18 13*s.* 4*d.* a ton; find the gain or loss per cent.
9. Divide a sovereign between A, B, C, so that A may have fourpence more than B, and B tenpence more than C.

10. A gives a fifth of a cake to B, and then a quarter of the remainder to C, and then a third of what still remains to D. What portions of the cake will A, B, C, D respectively have?

11. Which is the better investment, a four per cent stock at 120, or a five per cent stock at $166\frac{2}{3}$?

## XLI.

### University of Oxford, Eng.

*First Examination of Women, June, 1882. — Time allowed, 2 hours.*

1. How many coins, each weighing 15 dwts. 18 grains, can be made out of 16 pounds 10 ounces 7 dwts. 18 grains of metal?

2. Simplify $\frac{2\frac{2}{3} \text{ of } 5\frac{1}{6}}{13\frac{3}{7}} + \frac{4\frac{1}{4}}{3+\frac{1}{2\frac{1}{2}}} - \frac{5}{12} \div \frac{9}{17}$.

3. Reduce 6 cwts. 2 quarters 24 pounds to the fraction of a ton; and hence find the value at 17*s.* 6*d.* per ton.

4. If turf is sold in pieces 30 inches long and 9 inches wide at £1 0*s.* 10*d.* per 100 pieces, what is the price per square yard?

5. Find the cost of 1095 chests of tea at £7 17*s.* $7\frac{1}{2}d.$ per chest.

6. Reduce 0.00544 to a vulgar fraction in its lowest terms; multiply 0.544 by 0.125; and divide $27.\dot{6}$ by 276 to six places of decimals.

7. Reduce $2\frac{2}{3}$ of $4\frac{1}{2}d.$ to the decimal (i.) of half-a-crown, (ii.) of 7 half-crowns.

8. If 165 bales of goods cost £431 4*s.* $8\frac{1}{4}d.$, what will 264 of the same cost?

9. Find the simple interest on £844 4*s.* 4*d.* for $3\frac{1}{2}$ years at $4\frac{1}{4}$ per cent.

10. The material for a dress cost 7 guineas: if the price of the material chosen had been 25 per cent higher than it is, and half as much again had been used, by how much would the cost have been increased?

11. Divide £3 2*s.* 6*d.* between three persons so that the first shall have 7*s.* 6*d.* more than the second, and the second 5*s.* more than the third.

12. If $\frac{1}{15}$ of the pupils of a school are in the sixth form, $\frac{3}{20}$ in the fifth, $\frac{1}{4}$ in the fourth, and 96 in the lower forms, what is the whole number of pupils in the school?

## XLII.

### UNIVERSITY OF OXFORD, ENG.

*First Examination of Women, June, 1883. — Time allowed, 2 hours.*

1. Divide 436 acres 3 roods 3 yards 4 feet 72 inches by 19.

2. Simplify $1\frac{1}{18}$ of $6\frac{1}{4} - 7\frac{5}{8}$ of $1\frac{8}{17} + \dfrac{2}{5 + \dfrac{1}{6 + \frac{2}{11}}}$.

3. What fraction of £2 19*s.* $\frac{3}{4}d.$ is £1 12*s.* $9\frac{1}{4}d$?
If the larger of these sums is the value of 12 pennyweights of gold, of what weight of gold is the other the value?

4. A person, purchasing a carpet for a room 21 feet long and 15 feet 9 inches wide, chooses a material which is $\frac{3}{4}$ of a yard wide, and the pattern of which is

complete in each yard of length. How much carpet must he buy in order that the pattern may be unbroken, if the strips are to run lengthwise in the room?

5. Find the cost of 11 tons 3 cwts. 3 quarters 16 pounds at £3 12*s.* 11*d.* per cwt.

6. Multiply 25.3125 by 2.56; divide 648 by 0.0256; and from the sum of $2.\dot{6}$ and $3.58\dot{3}$ subtract 5.05.

7. Reduce £5 18*s.* 10½*d.* to the decimal of £25; and find the value of 0.025 of £1 + 0.35 of 17*s.* 6*d.* + 0.2 of 2½*d.*

8. If the food of 11 persons for 13 weeks costs £112 12*s.* 3*d.*, what will it cost to feed 26 persons for 11 weeks 5 days?

9. At what rate per cent per annum will £40 10*s.* be the simple interest on £432 for 2½ years.

10. A grocer buys 6 cwts. of tea for £70, and sells 4½ cwts. at 2*s.* 6*d.* per pound. At what price per pound must he sell the remainder to bring his profit on the whole to exactly 20 per cent?

11. A person, who had 2 sons and 4 daughters, left an estate of 2800 acres to be divided between them so that each son might have twice as much as each daughter. If one of his sons has a family of 4 sons and 2 daughters, and leaves his share to be divided in the same manner, how many acres will each of his daughters inherit?

12. From a cask of wine, worth 2*s.* 3*d.* per gallon, a sixth part is drawn and replaced by wine worth only 1*s.* 3*d.* per gallon. What is now the value per gallon of the wine in the cask?

## XLIII.

SCIENCE SCHOOLS AND CLASSES, ENGLAND.

*Mathematics, First Stage, May*, 1880.

Not more than three questions are to be answered. The number of marks assigned to each question is given in brackets.

1. Divide 285,651 by 77, using only short division. Obtain the remainder correctly, and explain briefly how you obtain it. [6.]

2. What interest per cent does a man get for his money by investing in the three per cents at 90?
   How much must he invest to give him an income of £1153 a year. [6.]

3. Add together $\frac{5}{9}$ of a guinea, $\frac{17}{20}$ of a half crown, $1\frac{7}{36}$ shillings, and $\frac{1}{6}$ of a penny, and reduce the whole to a decimal fraction of a pound. [8.]

4. A man owns three bills, of which one could be paid by a certain number of florins, another by twice that number of half crowns, and the third by six times that number of shillings. The bills amount in all to £7 3*s*. 0*d*. What are the several amounts? [12.]

5. Copper weighs 550 pounds, and tin 462 pounds to the cubic foot. What will be the weight of a cubic foot of a mixture of 6 parts copper to 5 parts tin? [12.]

6. A plate of metal is 106.58 inches long, 14.6 inches wide, and 2 inches thick. Supposing it to be melted, and cast into an exact cube, what would be the edge of the cube? [12.]

## XLIV.

SCIENCE SCHOOLS AND CLASSES, ENGLAND.

*Mathematics, First Stage, May*, 1881.

**Not more than three questions are to be answered. The number of marks assigned to each question is given in brackets.**

1. Make out a bill for the following:
   1 cwt. of indigo at 14*s.* 6*d.* per pound.
   1 ton of cloves at 1*s.* 2*d.* per pound.
   5 cwt. 3 quarters 18 pounds spelter at 4½*d.* per pound.
   7 cwt. 1 quarter 14 pounds block tin at £64 per ton.
   Subtract 10 per cent discount for cash. [7.]
2. Divide 0.736 by 2.85, and 2.85 by 0.0736, in each case to four places of decimals, and find the product formed by multiplying the two quotients together. [7.]
3. Find the G.C.M. and L.C.M. of 3024, 4752, and 7488. [8.]
4. A man invests £3600 in 3 per cent stock at 90. He sells out at 80, and lends $\frac{5}{8}$ of his money at 4 per cent, and $\frac{3}{8}$ at 5 per cent. How long must the loan last, so that when he re-invests his money in 3 per cents at 90, his gain on interest (simple) may exactly equal his loss upon principal? [12.]
5. The sides of a rectangle are 16 feet and 10 feet long respectively. Find, to four places of decimals, the length of the diagonal of a square whose area equals that of the rectangle. [12.]
6. Seventy-five per cent of the area of a farm is arable; of the remainder 85 per cent is pasture, and the rest is waste; the area of the waste is 3 acres 0 roods 20 poles. What is the area of the farm? [12.]

## XLV.

SCIENCE SCHOOLS AND CLASSES, ENGLAND.

*Mathematics, First Stage, May*, 1882.

Not more than three questions are to be answered. The number of marks assigned to each question is given in brackets.

1. The cost of labor in producing a certain article was £18 19*s*. 11*d*. It was made by five persons, who severally spent 2, 3, $4\frac{1}{2}$, 6, and 8 days upon it. How should the money be divided among them? [6.]

2. Reduce to their lowest terms the fractions

$$\frac{\frac{3}{4} \text{ of } 0.0603}{\frac{5}{4} \text{ of } 0.00594} \text{ and } \frac{1}{3\frac{1}{9}} \text{ of } 4\tfrac{1}{8} \text{ of } \frac{\frac{1}{2}+\frac{1}{3}+\frac{1}{4}}{\frac{1}{4}+\frac{1}{5}+\frac{1}{6}}.$$ [6.]

3. Arrange $\frac{1}{0.742}$, $\sqrt{1.81}$, and 1.346 in order of magnitude, and find to five places of decimals by how much the sum of the largest and smallest of these numbers differs from twice the other number. [8.]

4. What is discount? How is it commonly calculated? If a sum of £1000 becomes due three months hence, what is its present value as commonly calculated, and what as correctly calculated, interest being reckoned at 5 per cent? [10.]

5. Given that a meter equals 3.2809 feet; find how many square meters there are in 1000 square yards. [10.]

6. A cubic foot of copper weighs 560 pounds. It is rolled into a square bar 40 feet long. An exact cube is cut from the bar. What is its weight to four decimals of a pound? [12.]

## XLVI.

SCIENCE SCHOOLS AND CLASSES, ENGLAND.

*Mathematics, First Stage, May*, 1883.

Not more than three questions are to be answered. The number of marks assigned to each question is given in brackets.

1. What is a decimal fraction? What is a recurring decimal? Express $\frac{10}{37}$ as a recurring decimal, and 0.0173535 ..... as a vulgar fraction. [6.]
2. Show that the square root of 0.37 exceeds the cube root of 0.217 by a difference which very nearly equals $\frac{1}{136}$. [10.]
3. A publisher sells books to a retail dealer at 5*s.* a copy, but allows 25 copies to count as 24; if the retailer sells each of the 25 copies for 6*s.* 9*d.*, what profit per cent does he make? [8.]
4. In building a wall, 22,500 bricks are used at £1 12*s.* a thousand, 135 bushels of lime at 1*s.* 4½*d.* a bushel, 16½ loads of sand at 3*s.* 6*d.* a load; the labor is reckoned at 9*s.* 6*d.* per thousand bricks laid; and 300 coping stones are used at 1*s.* 7½*d.* apiece, including cost of laying. Make out the above in the form of a bill, and find the amount after deducting 7½ per cent for prompt payment. [8.]
5. The capital of a trading company consists of 4000 A shares of £80 each and 2000 B shares of £25 each; in dividing the profits, 5 per cent of the amount of each share is first paid, and then the remainder, if any, is divided equally amongst the shareholders. The profits of the undertaking in one year were £34,853 12*s.* 6½*d.*; how much would be paid to the holder of an A share and how much to the holder of a B share? [10.]

6. An imperial gallon is 277.274 cubic inches; a Winchester bushel, 2150.42 cubic inches; how many Winchester bushels are equal to 100 imperial bushels? [6.]

## XLVII.

### Civil Service of Great Britain.

*Open Competitive Examination for Out-Door Officers of Customs, July, 1876. — Time Allowed, 2½ Hours.*

1. Add together $4\frac{3}{8}$, $2\frac{5}{6}$, $\frac{13}{24}$, and $\frac{5}{36}$.
2. Subtract $3\frac{13}{14}$ from $5\frac{5}{42}$.
3. Multiply together $5\frac{7}{9}$, $\frac{6}{17}$, $\frac{8}{18}$, and $2\frac{5}{6}$.
4. Divide $5\frac{4}{7}$ by $\frac{13}{14}$.

5. Add together 0.00867, 1.92, 0.806, and 143.9576.
6. Subtract 382.7043 from 400.1036.
7. Multiply 381.42 by 0.0065.
8. Divide 1522.038 by 0.372.
9. Express $\frac{3}{7}$ of 4*s.* 1*d.* as the decimal of 5 guineas.

10. Add together $\frac{2}{3}$, $\frac{14}{25}$, $11\frac{4}{15}$, and $\frac{17}{30}$.
11. Subtract $8\frac{4}{7}$ from $9\frac{1}{18}$.
12. Multiply together $\frac{14}{17}$, $3\frac{5}{7}$, $3\frac{7}{9}$, and $\frac{11}{12}$.
13. Divide $4\frac{10}{11}$ by $10\frac{4}{11}$.

14. Add together 0.725 of a bushel and 2.079 of a gallon, and give the answer in pints and the decimal fraction of a pint.
15. Subtract 10.869 of an ounce from 1.203 of a pound Troy.

16. Multiply 905.8 by 87.06.

17. Divide 0.0054837 by 0.0135.

18. Reduce 0.70596 of 3*s.* 11½*d.* to farthings and the decimal of a farthing.

19. Reduce 4 tons 2 cwt. 1 quarter 11 pounds to ounces.

20. If 2¼ pounds of rice cost 7*d.*, how much may be bought for £6 17*s.* 1*d.*?

21. Find (by practice) the cost of 455,436 articles at £2 13*s.* 10½*d.* per dozen.

22. In what time will £1225 amount to £1417 18*s.* 9*d.* at 3 per cent per annum simple interest?

23. In 8,476,321 inches, how many miles, furlongs, poles, etc.

24. If 2½ acres of pasturage can support 5 oxen for 3½ days, how many would be required to support 26 oxen for 17½ days?

25. Find (by practice) the value of 5 quarters 2 bushels 1 peck of wheat at £4 18*s.* a quarter.

26. Find the amount of £4750 in 3 three years at 5 per cent per annum, compound interest, neglecting fractions of a penny.

## XLVIII.

### Civil Service of Great Britain.

*Open Competitive Examination for Men Clerkships in the Lower Division of the Civil Service, Nov.*, 1876.—*Time allowed*, 3 *hours.*

1. A and B together earn £3 16*s.* in 8 days, A and C together can earn £7 13*s.* in 17 days, and B and C together £12 15*s.* in 30 days. How much can they severally earn alone?

2. Express 32,567,325 in the duodenary scale.
3. A merchant selling goods at a certain price loses 5 per cent; but, if he had sold them for £4 more, he would have gained 3 per cent. What did the goods cost him?
4. Multiply by duodecimals 3 feet 2 inches by 5 feet 7 inches, and the product by 6 feet 8 inches. What does the answer become when expressed in cubic inches and the decimal fraction of a cubic inch?
5. Extract the square root of $109\frac{228}{729}$, and find the side of a cube containing 2,048,383 cubic inches.
6. What is the present worth of £1801 11*s.*, payable $6\frac{1}{4}$ years hence, at 5 per cent per annum?
7. A bill upon Amsterdam is bought at 12 florins per pound sterling; the proceeds purchase at Amsterdam bills upon Hamburg, at $34\frac{1}{4}$ florins for 40 marks; these are forwarded to Paris and sold at 185 francs per 100 marks. What is the rate of exchange between London and Paris?
8. A train is just 27 minutes in passing through the Mont Cenis Tunnel, the length of which is 11,220 meters; find the speed of the train in miles per hour. (One meter equals 39.39 inches.)
9. In Reaumur's thermometer the freezing point is zero, and the boiling point 80°; in Fahrenheit's thermometer the freezing point is 32°, and the boiling point 212°. What will Reaumur's thermometer mark when Fahrenheit's marks 47°, and what will Fahrenheit's mark when Reaumur's marks 93°?
10. A and B rent a pasture for £138 per annum; A puts in 200 sheep and B 160, but at the end of six months they dispose of half their stock, and allow C to put in 120; what should A, B, and C pay severally towards the rent at the year's end?

**11.** It is noticed that the water in a reservoir 38 feet long and 26 feet wide, which is known to leak, sinks one inch in 12 hours. A pipe discharging 60 gallons per minute will fill the reservoir in 45 hours, allowing for the leakage. Find within an inch the depth of the reservoir. (A cubic foot of water contains 6.25 gallons.)

**12.** A man invests £26,180 in the 3 per cents at 93½, but after a time sells out half at 92¼, and invests the proceeds in the 4 per cents at 97. Find to a penny the difference in his income.

**13.** Find the value of 3.6 of $0.9\dot{5}\dot{4}$ of $0.4\dot{2}8571\dot{4}$ of 2*s.* 3*d.*

**14.** A watch gains 1 minute and 15 seconds a day. It is set right at noon on the 12th of November. What will be the true time when it points at noon on the following Christmas day?

**15.** The first of a line of 10 sentries, standing at equal distances from each other, wishes to send a message of 20 words to the last. The men begin to walk at the same instant, and walk even distances right and left of their posts alternately, and each time they meet pass on 5 words. The transmission of the message occupies 48 minutes, and the men walk at the rate of 3 miles per hour. How far is the first man from the last?

## XLIX.

CIVIL SERVICE OF GREAT BRITAIN.

*Competitive Examination for the Excise, Dec.*, 1876. — *Elementary Arithmetic.* — *Time Allowed, 2½ hours.*

**1.** In 372,483 ounces, how many tons, cwts., quarters, etc.

**2.** If cotton is shipped at 4 guineas a cwt., what is the weight of a bale costing £21 9*s.*?

3. Find (by practice) the value of 27 pounds 6 ounces 6 dwts. of gold dust at £3 10*s.* 5*d.* an ounce.

4. Find the simple interest on £6250 for 18 years at $2\frac{1}{2}$ per cent per annum.

5. Add together $5\frac{3}{7}$, $\frac{14}{15}$, $\frac{19}{42}$, and $3\frac{1}{8}$.

6. Subtract $9\frac{3}{13}$ from $10\frac{1}{143}$.

7. Multiply $6\frac{3}{10}$ by $\frac{25}{27}$.

8. Divide $31\frac{7}{9}$ by $1\frac{62}{81}$.

9. Add together
371.87001, 0.0031, 0.00631, and 5786.44321.

10. Subtract 185.939131 from 186.847.

11. Multiply 323.211 by 0.20343.

12. Divide 343.5777 by 0.525 to three places of decimals.

13. What fraction of a sovereign is 0.345 of £1 4*s.*?

14. Reduce 3 quarters 7 bushels 1 gallon to pints.

15. The market price of wheat being £3 4*s* per quarter, what will be the value of 11 bushels and 3 pecks?

16. Find (by practice) the dividend on £3760 15*s.* at 17*s.* 9*d.* in the pound.

17. Find the amount of £4096 in 3 years at $1\frac{1}{4}$ per cent compound interest (neglecting fractions of a penny).

18. Add together $5\frac{11}{18}$, $\frac{7}{8}$, $3\frac{4}{27}$, and $1\frac{1}{16}$.

19. Subtract $\frac{8}{17}$ from $\frac{7}{13}$.

20. Multiply together $5\frac{6}{17}$, $\frac{85}{144}$, $\frac{36}{49}$, and $1\frac{1}{13}$.

21. Divide $\frac{17}{96}$ by $6\frac{3}{8}$.

22. Add together 11.431, 0.00101, 243.734, 400, and 1.3743.

23. Subtract 876.315 from 1000.01.

24. Multiply 7.3406 by 0.00437.

25. Divide 0.003634 by 0.0632.

26. Find the value of 0.0625 of an acre.

27. Reduce 1 mile 7 furlongs 5 perches $2\frac{1}{2}$ yards to inches.

28. If 49 men can empty a reservoir in 65 days, pumping 8 hours a day, how many hours a day must 196 men pump to empty it in 26 days?

29. Find (by practice) the value of 7719 articles at £1 7*s.* 6*d.* per dozen.

30. At what rate per cent will £461 10*s.* amount to £611 9*s.* in 13 years at simple interest?

31. Add together $\frac{4}{9}$, $\frac{7}{18}$, $1\frac{5}{36}$, and $\frac{1}{81}$.

32. Subtract $12\frac{3}{11}$ from $15\frac{2}{33}$.

33. Multiply together $\frac{7}{18}$, $3\frac{1}{12}$, $1\frac{7}{11}$, and $\frac{9}{14}$.

34. Divide $5\frac{2}{7}$ by $\frac{74}{343}$.

35. Add together 1.001 of a cwt. and 0.039 of a quarter, and give the answer in ounces and the decimal fraction of an ounce.

36. Subtract 0.335 of a gallon from 12.51 of a quart, and give the answer in pints and the decimal of a pint.

37. Multiply 0.003631 by 200.001.

38. Divide 28.028 by 4900.

39. Reduce 13*s.* 6*d.* to the decimal of £3.

## L.

### Civil Service of Great Britain.

*Competitive Examination for the Excise, Dec.*, 1876. — *Higher Arithmetic.* — *Time allowed*, 3 *hours.*

1. An estate is divided among three persons, A, B, C, so that A has $\frac{5}{8}$ of the whole, and B has twice as much as C. It is found that B has 27 acres more than C. How large is the estate?

2. 2 cwts. 1 quarter 3 pounds of an article is bought for 15 *s.*, and 17 pounds is sold for 1 *s.* 3 *d.* What profit is made per cent?

3. What fraction of 300 yards is 1 furlong 2 poles 6 yards 2 feet? Express the answer as a decimal.

   Express as a fraction of an acre the ground taken up by a path 3 feet broad round a house, the front of which is 57 feet, and side 37 feet long.

4. Extract the square root of $30{,}789\frac{68}{289}$, and the cube root of 2,326,203.125.

5. How many ounces of silver are there in a piece of plate costing £59 10 *s.*, the price of silver being 0.255 of £1 per ounce, and the cost of manufacture $\frac{1}{8}$ the value of the silver used?

6. Explain what is meant by the L.C.M. of two or more numbers?

   Find the L.C.M. of 3696, 286, 19,656.

7. Find the value of $1.7\dot{2}$ of $0.\dot{2}7\dot{6}$ of 15.

8. How much must a man invest in $3\frac{1}{2}$ per cents at 91 in order to receive £590 per annum, after paying 4 *d.* in the pound income tax?

9. The difference between the discount and interest on a debt due a year and a quarter hence, at 4 per cent, is 5*s*. What is the debt?

10. A tradesman's prices are 12 per cent above cost price. If he allows £1 6*s*. 3*d*. discount on a bill of £21, what profit does he make per cent?

11. A man rents a house from the first of January at £142 per annum, payable half-yearly. He sublets it for £160 per annum, payable quarterly. Allowing simple interest at 4 per cent, what will he make by the transaction in 3 years?

12. A cistern containing 600 gallons measures externally 7 feet in length, 2 feet 11 inches in breadth, and 5 feet 6 inches in height. The sides being $1\frac{1}{2}$ inches thick, what is the thickness of the bottom? (A cube foot of water contains $6\frac{1}{4}$ gallons.)

13. The map of a country is drawn on the scale of $\frac{1}{10}$ of an inch to a mile. What area on the map will represent a lake 4000 acres in extent?

14. A fast train leaves a place A for another place B at the same moment that a slow train leaves B for A. The fast train takes 2 hours on the journey, and, if the slow train kept its time, they would meet at a distance from B equal to $\frac{3}{5}$ the whole distance from A to B. Instead of this, the place where they meet is at a distance from B equal to $\frac{1}{4}$ the distance from A to B. How much behind time will the slow train be when it arrives at A?

15. A round column stands on a cubic pedestal of the same material, whose edge is 6 feet. The column is hollow, the external and internal diameters measuring 5 feet and 4 feet, respectively. If the weight of the column be the same as that of the pedestal, what is its height?

## LI.

### Civil Service of Great Britain.

*Open Competitive Examination for Clerkships of the Superior Class in the India Office*, 1879. — *Elementary Arithmetic.* — *Time allowed*, $2\frac{1}{2}$ *hours.*

1. Reduce 6 tons 3 cwts. 2 quarters 14 pounds to ounces.
2. What must be given for a piece of silver weighing 73 pounds 5 ounces 15 pennyweights, at the rate of 5*s.* 9*d.* an ounce?
3. Find (by practice) the value of 1 ton 3 cwts. 1 quarter 14 pounds at £3 10*s.* per ton.
4. Find the simple interest on £840 15*s.* for $6\frac{3}{4}$ years at 3 per cent per annum (neglecting fractions of a penny).
5. Add together $\frac{17}{25}$, $4\frac{1}{8}$, $\frac{13}{75}$, and $1\frac{2}{15}$.
6. Subtract $7\frac{8}{11}$ from $12\frac{1}{48}$.
7. Multiply $8\frac{8}{11}$ by $2\frac{8}{26}$.
8. Divide $3\frac{8}{17}$ by $2\frac{14}{51}$.
9. Add together 3106.8157, 0.0624, 0.00441, and 43.2875.
10. Subtract 84.937658 from 100.3062431.
11. Multiply 947.36 by 0.00423.
12. Divide 950.562 by 19.56 to three places of decimals.
13. Reduce 0.0016395 of a pound Troy to grains and the decimal of a grain.
14. Reduce 8,868,097 square feet to acres, roods, perches, and yards.

15. If 10 men can build a wall 65 feet long and 5 feet high in $3\frac{1}{4}$ days, in how many days will 6 men build a wall 80 feet long and 4 feet high?

16. Find (by practice) the dividend on £8236 10*s.* at 4*s.* 7*d.* in the pound.

17. Find the amount of £7205 in 3 years at 6 per cent compound interest (neglecting fractions of a penny).

18. Add together $\frac{1}{3}$, $\frac{1}{15}$, $\frac{1}{18}$, and $4\frac{1}{6}$.

19. Subtract $1\frac{1}{3}$ from $3\frac{1}{18}$.

20. Multiply together $\frac{2}{3}$, $\frac{5}{7}$, $1\frac{3}{4}$, and $1\frac{1}{3}$.

21. Divide $10\frac{1}{3}$ by $1\frac{11}{16}$.

22. Add together 16.41215, 9.376, 0.00403, 177.42, and 27.03067.

23. Subtract 17.2398 from 27.06.

24. Multiply 46.2375 by 0.00743.

25. Divide 92.3784 by 0.623 to four places of decimals.

26. Find the value of 1.025 of £1 13*s.* 4*d.*

27. In 406,395 pints how many bushels, pecks, gallons, etc.?

28. If the 6*d.* loaf weigh 4 pounds, when wheat is at 36*s.* a quarter, what should the 1*d.* loaf weigh when wheat is at 48*s.* a quarter?

29. Find (by practice) the value of 17 ounces 10 pennyweights 12 grains at £1 13*s.* 4*d.* an ounce.

30. At what rate per cent will £2100 amount to £5250 in 3 years?

31. Add together $5\frac{3}{7}$, $\frac{11}{4}$, $\frac{3}{8}$, and $\frac{13}{56}$.

32. Subtract $8\frac{7}{9}$ from $12\frac{3}{14}$.

33. Multiply together $10\frac{1}{2}$, $2\frac{5}{6}$, $\frac{4}{7}$, and $3\frac{3}{20}$.

34. Divide $10\frac{4}{5}$ by 13.

35. Add together 3.062 of a day and 1.5347 of an hour, and give the answer in minutes and the decimal fraction of a minute?

36. Subtract 5.017 of a furlong from 1.358 of a mile, and give the answer in yards and the decimal fraction of a yard?

37. Multiply 34.0069 by 0.005006.

38. Divide 0.038452 by 0.1005 to three places of decimals.

39. Reduce £1.00065 to farthings and the decimal of a farthing.

## LII.

### Civil Service of Great Britain.

*Open Competitive Examination for Clerkships of the Superior Class in the India Office*, 1879. — *Higher Arithmetic.* — *Time allowed*, 3 *hours.*

1. If 26 sheep be worth 5 oxen, 2 oxen be equal in value to 3 horses, and 7 horses can be purchased for 91 guineas, find the value of 1 sheep.

2. Simplify the following, and express the results as decimals:

   (i.) $(2 \div 1\frac{1}{2}) \times (3 \div 2\frac{2}{3}) \times (4 \div 3\frac{3}{4})$.

   (ii.) $\dfrac{2\frac{1}{5} \text{ of } 3}{3\frac{2}{3} \text{ of } 2} - \dfrac{1\frac{1}{2} \text{ of } 2\frac{2}{3}}{3\frac{3}{4} \text{ of } 4\frac{4}{5}} + \dfrac{\frac{14}{17}}{2\frac{1}{3}} - \dfrac{2\frac{2}{3} - 1\frac{1}{2}}{2\frac{2}{3} + 1\frac{1}{2}}$.

   (iii.) $0.1\dot{6} \div 0.00\dot{2}\dot{7}$.

3. Divide 987,654,321 by 3509, and 0.00321 by 0.000011. Find the value of $2.01\dot{3}\dot{6}$ of £2 1 *s.* 3 *d.*

4. Explain what is meant by the G.C.M. and the L.C.M. of several arithmetical quantities.

Find the G.C.M. of 5049, 4301, 3553.

The driving-wheel of a locomotive engine is 27½ feet in circumference, and the fore-wheel 16 feet. Two particular spokes, one in each wheel, are observed pointing vertically upwards. How far will the engine travel before the same two spokes are again simultaneously in the same direction, and how often will this happen in 9 miles?

5. What is the present worth of £1866 16*s.*, payable 2 years hence at 3 per cent per annum?

6. The area of a rectangular piece of ground is 87 acres 1 rood 26 perches. What is its length, its breadth being 462.5 links?

7. A block of granite is 17.7 feet broad, 9.4 thick; what length must be cut off so as to contain 554.6 cubic feet?

8. Find the square root of 1,874,161. Extract to 4 places of decimals the cube root of 0.002.

What must be the side of a cubical cistern which is to contain 1000 gallons of water, if a gallon contains 277.164 cubic inches?

9. A grocer mixes 2 kinds of sugar at 4*d.* and 6½*d.* per pound, taking 3 pounds of the first to 2 of the second. At what price per pound must he sell the mixture to gain a profit of 20 per cent?

10. Divide £144 10*s.* among 3 persons in the proportions of 0.3, 0.33, and $0.\dot{3}$.

11. A merchant invests half of a sum of money in the 3 per cents at 92, and the other half in the 3½ per cents at 98. Which is the better investment? If he receives £44 as income, what is the amount of the sum?

12. A man insures to the value of £445 6*s.* 8*d.* on goods, the rate of insurance being $4\frac{3}{8}$ per cent. Losing the goods by an accident, he finds that he recovers both their value and the premium paid. What was their actual value?

13. Find the cost, at 4 guineas per 100 square feet, of laying in stone the ground floor of a house which measures 21 feet by 18 feet, allowing for each of 4 fire-places a space 3 feet by 2 feet 6 inches, and for the well-hole of the staircase a space of 9 feet square.

14. A cistern can be filled by 1 tap in 3 hours, by another in 3 hours and 40 minutes, and emptied by a third in 2 hours and 20 minutes. If they are all opened together, in what time will the cistern be filled?

15. Reduce to a decimal, accurate to 7 places,

$$\frac{1}{1\times 3}+\frac{1}{1\times 3\times 5}+\frac{1}{1\times 3\times 5\times 7}+\text{etc.}$$

## LIII.

### Civil Service of Great Britain.

*Open Competitive Examination for Admission to the Royal Indian Engineering College, July, 1879. — Time Allowed, 3 hours.*

1. Add together $5\frac{2}{9}$, $3\frac{7}{18}$, $2\frac{7}{36}$, $\frac{11}{12}$, and $2\frac{1}{3}$.
2. Subtract $3\frac{5}{7}$ from $4\frac{3}{5}$.
3. Multiply together $1\frac{4}{11}$, $2\frac{3}{15}$, $2\frac{25}{48}$, $1\frac{3}{17}$, and $\frac{51}{55}$.
4. Divide $10\frac{18}{28}$ by $1\frac{9}{115}$.

5. Add together 12.613, 0.00175, 257.8425, and 0.001345.
6. Subtract 17.9159 from 230.775.

7. Multiply 35.6 by 0.01094.
8. Divide 10.8528 by 1.02.
9. Express 2 cwt. 3 quarters 3 pounds 8 ounces as the decimal of a ton.

10. Add together $\frac{11}{17}$, $\frac{19}{221}$, and $2\frac{7}{13}$.
11. Subtract $6\frac{5}{11}$ from $7\frac{3}{8}$.
12. Multiply together $3\frac{5}{8}$, $\frac{17}{85}$, $2\frac{11}{12}$, $\frac{60}{81}$, and $\frac{14}{15}$.
13. Divide $3\frac{14}{15}$ by $7\frac{24}{25}$.

14. Add together 5.75 of a bushel and 3.625 of a quart, and give the answer in gallons and the decimal of a gallon.
15. Subtract 7.3125 of a furlong from 1.03125 of a mile; give the answer in yards and the decimal of a yard.
16. Multiply 7.50605 by 1.0907.
17. Divide 145.0052 by 0.00785.
18. Reduce 3.031 pounds to grains and the decimal of a grain.

19. How many days of 8 hours each will it take to dig a ditch 2 yards wide, enclosing a square plot containing 360,000 square feet, at the rate of $2\frac{1}{2}$ yards in $3\frac{3}{4}$ hours?
20. Multiply by duodecimals 3 feet 2 inches 7 parts by 5 feet 1 inch 3 parts, and the product by 2 feet 7 inches. Give the answer in cubic feet, cubic inches, and the fraction of a cubic inch.
21. The walls of a room 21 feet long, 15 feet 9 inches wide, 11 feet 8 inches high, are painted at an expense of £17 17*s*. $3\frac{1}{2}$*d*. Find the additional expense of painting the ceiling at the same rate.

22. A ditch has to be made 360 feet long, 10 feet wide at the top and 3 feet wide at the bottom, the angle of the slope of each side being 45°. Find the number of cubic yards to be excavated.

23. A circular pond has an area of $346\frac{1}{2}$ square yards. Find to the nearest penny the cost of fencing it round at 4*s.* 6*d.* per lineal yard.

24. A cubical block contains 1 cubic yard, 2 cubic feet, 541 cubic inches. Find the cost of covering the entire surface with lead at 1*s.* 6*d.* per square foot.

25. A hemispherical punch-bowl is 5 feet 6 inches round the brim. Supposing it to be half full, how many persons may be helped from it in hemispherical glasses $1\frac{3}{4}$ inches in diameter?

## LIV.

### Civil Service of Great Britain.

*Open Competitive Examination for Admission to the Royal Indian Engineering College, July*, 1880. — *Time Allowed*, 3 *hours.*

1. Add together $4\frac{1}{10}$, $7\frac{9}{35}$, $1\frac{1}{7}$, $\frac{13}{14}$, and $1\frac{17}{21}$.
2. Subtract $2\frac{9}{10}$ from $3\frac{8}{13}$.
3. Multiply together $1\frac{5}{11}$, $17\frac{1}{8}$, $1\frac{15}{47}$, $1\frac{1}{93}$, and $2\frac{5}{39}$.
4. Divide $7\frac{5}{29}$ by $3\frac{11}{145}$.

5. Add together 17.429, 0.0173, 1156.8, and 0.0001723.
6. Subtract 60.25738 from 356.17.
7. Multiply 7.18 by 0.0919.
8. Divide 331.8553 by 55.3.
9. Express 1 peck 1 gallon 3 quarts as the decimal of a quarter.

10. Add together $\frac{1}{15}$, $\frac{1}{17}$, and $1\frac{101}{105}$.

11. Subtract $19\frac{1}{19}$ from $20\frac{1}{20}$.

12. Multiply together $2\frac{1}{8}$, $1\frac{1}{84}$, $1\frac{4}{17}$, and $\frac{8}{85}$.

13. Divide $7\frac{11}{12}$ by $1\frac{23}{24}$.

14. Add together 2.25 of a cwt. and 5.76 of an ounce, and give the answer in quarters and the decimal of a quarter.

15. Subtract 18.75 dwts. from 2.12875 pounds, and give the answer in grains and the decimal of a grain.

16. Multiply 42.317 by 10.075.

17. Divide 48 by 0.144.

18. Reduce 19.062 furlongs to inches and the decimal of an inch.

19. A steel plate is 11 feet 6 inches 5′ long, 3 feet 2 inches 8′ wide, and 1 inch 3′ thick. Find, by duodecimals, the number of cubic feet, cubic inches, etc., it contains.

20. Two circular courts measure 40 and 50 feet in diameter. The paving of the former costs £74 16*s.* 8*d.* Find the cost of paving the latter at the same rate.

21. A rectangular room has its length, breadth, and height as 7, 6, 5, respectively. Its walls were decorated at a cost of 2*s.* 6*d.* per square yard, and its ceiling finished at the same rate. The bill for the whole was £86. What will be the expense of covering the floor with carpet at 7*s.* per square yard?

22. Find the cost of constructing a hemispherical dome of stone, the internal diameter of which is 45 feet, and uniform thickness 18 inches, at 4*s.* 1*d.* per cubic foot of masonry.

23. The diameters of a conical frustum of marble are $17\frac{1}{2}$ and $10\frac{1}{2}$ inches, and the height 24 feet. Find its volume.

24. A and B receive 1600 cabbages to plant, but of these 10 prove worthless. A plants 5 while B plants 4, and the rows are equal. After some hours they have not sufficient between them to complete another row, A having 45 to spare and B 6. A then finds he has planted three rows more than B. How many did each plant, and how many cabbages in a row?

25. A fast train, travelling at the rate of 36 miles per hour, leaves Dover for London, 79 miles distant, at 8 A.M., and is shortly after followed by a slow train whose speed is 24 miles per hour. The former train meets at 8.45 the express from London, which covers 48 miles in the hour; and the slower train from Dover meets the express $12\frac{1}{2}$ minutes later. Find at what time the express leaves London and the slow train Dover, supposing both trains to travel uniformly between Dover and London.

## LV.

### Civil Service of Great Britain.

*Competitive Examination of Candidates nominated for Appointments in the India Forest Department, Jan.*, 1880. — *Elementary Arithmetic.* — *Time allowed*, $2\frac{1}{2}$ *hours.*

1. Reduce 4 tons 1 cwt. 11 pounds to ounces.

2. If 1 pound 2 ounces 5 pennyweights of gold cost £69 9*s.* $4\frac{1}{2}$*d.*, what is the price per ounce?

3. Find (by practice) the value of 2 cwts. 2 quarters 21 pounds at £4 per ton.

4. Find the simple interest on £3650 for 8 years at $3\frac{3}{4}$ per cent per annum.

5. Add together $\frac{3}{5}$, $\frac{3}{8}$, $\frac{1}{4}$, and $\frac{7}{11}$.

6. Subtract $2\frac{1}{17}$ from $4\frac{8}{20}$.

7. Multiply $5\frac{1}{3}$ by $1\frac{1}{3}$.

8. Divide $5\frac{6}{11}$ by $2\frac{1}{2}$.

9. Add together 0.20765, 0.00631, 6758.13247, and 5.973.

10. Subtract 39.984 from 400.29.

11. Multiply 62.093 by 2.568.

12. Divide 14.9455 by 35.5.

13. Reduce 0.325 of 10 cwts. to pounds.

14. Reduce 2 pounds 3 ounces 4 pennyweights to grains Troy.

15. If 3 acres 2 roods of land cost £375, what will be the value of 4 acres 2 roods 29 perches?

16. Find (by practice) the value of 32,679 articles at £1 11*s.* 6*d.* per dozen?

17. Find the amount of £2930 in 3 years at 2 per cent per annum compound interest.

18. Add together $2\frac{5}{6}$, $\frac{11}{14}$, $3\frac{1}{3}$, and $\frac{5}{7}$.

19. Subtract $15\frac{15}{16}$ from $20\frac{8}{25}$.

20. Multiply together $2\frac{3}{4}$, $4\frac{4}{5}$, $5\frac{5}{6}$, and $\frac{1}{7}$.

21. Divide $\frac{16}{27}$ by $2\frac{1}{3}$.

22. Add together 0.61692, 243.734, 400, 67.45213, and 2.683.
23. Subtract 284.7654 from 321.07659.
24. Multiply 2.8456 by 0.00325.
25. Divide 85.5 by 0.00684.
26. Express 3*s.* 9*d.* as the decimal of a pound.
27. In 1,320,765 square inches, how many acres, roods, perches, etc.?
28. If the second class railway fare is $\frac{3}{5}$ that of the first, and the third class $\frac{1}{2}$ that of the second, and a first class passenger can travel 125 miles for £1 11*s.* 3*d.*, how far can a third class passenger travel for 8*s.* 4*d.*?
29. Find (by practice) the dividend £269 17*s.* 6*d.* at 13*s.* 10*d.* in the pound.
30. In what time will £1050 amount to £1548 1*s.* 10½*d.* at 5¾ per cent per annum simple interest?

31. Add together $5\frac{11}{18}$, $2\frac{3}{4}$, $\frac{9}{26}$, and $\frac{15}{52}$.
32. Subtract $9\frac{9}{19}$ from $19\frac{4}{57}$.
33. Multiply together $\frac{12}{35}$, $2\frac{5}{9}$, $\frac{8}{106}$, and $1\frac{7}{46}$.
34. Divide $4\frac{4}{5}$ by $6\frac{2}{3}$.

35. Add together 0.32 of a pound and 0.45 of a shilling, and give the answer in pence and the decimal fraction of a penny.
36. Subtract 0.428 of a gallon from 3 quarts 1.25 pints, and give the answer in pints and the decimal of a pint.
37. Multiply 0.07864 by 0.000973.
38. Divide 16.8951 by 28,300.
39. Express 3 furlongs 2 poles as the decimal of 2½ miles.

## LVI.

### CIVIL SERVICE OF GREAT BRITAIN.

*Competitive Examination of Candidates Nominated for Appointments in the India Forest Department, Jan., 1880.— Higher Arithmetic.— Time Allowed, 2½ hours.*

1. Find the square root of 64.55961801, and of $70\frac{21}{289}$.
2. Resolve 2520, 2772, and 30,888 into their prime factors, and thence deduce their L.C.M.
3. Find the value of $\left(4\frac{3}{8} \div \frac{9\frac{1}{10} \div \frac{2}{11}}{2\frac{6}{7} \div \frac{1}{42}}\right) \times 0.3\dot{6} \times 0.2\dot{3}\dot{6}$ of 11 shillings.
4. Divide £3293 6*s.* 6*d.* among 5 persons in the proportion of the fractions $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, and $\frac{1}{7}$.
5. Multiply (by duodecimals) 4 feet 3 inches 7 parts by 2 feet 6 inches 3 parts, and the product by 8 feet 9 inches. What does the answer become when expressed in cubic feet, cubic inches, and the fraction of a cubic inch?
6. Find the length of the edge of a cube containing 12 cubic feet 1216 cubic inches, and the cost of covering this cube with copper at $10\frac{1}{2}$*d.* per superficial foot.
7. A plot of land, containing 4 acres 3 roods 20 perches, is valued in 1879 at £1681 17*s.* 6*d.*, being 15 per cent more than it was estimated to be worth in 1878. What was the estimated value per acre in 1878.
8. A man has £5000 of stock in the 3 per cents. He sells out when they are at 98, and invests £2000 in India stock at 104, paying 4 per cent, and the remainder in railway shares at $87\frac{1}{2}$, paying 5 per cent. Find to a penny the alteration in his income.

9. A cistern, measuring inside 4 feet 9 inches long, 3 feet 6 inches wide, and 3 feet deep, is filled with water. Find approximately the number of gallons it contains, and the weight of water on a square inch of the bottom. (A cubic foot of water is equal to 6.25 gallons, and weighs 62.321 pounds.)

10. A sovereign of standard gold weighs 5.136 dwts., and a shilling of standard silver weighs $\frac{1}{60}$ of a pound Troy. What weight of standard silver is equivalent in value to 5 ounces of standard gold?

11. A water-tank can be filled by one tap in 3 hours, and by another in 2 hours. It can be emptied by a third tap in 1 hour 24 minutes. The tank being empty, all three taps are opened at once. Required the time of filling it under these circumstances.

12. A starts to walk from London to Croydon, a distance of 10 miles, at the same moment that B leaves Croydon for London. A walks at the rate of 3 miles an hour, and B at the rate of $2\frac{3}{4}$ miles an hour; but, soon after they started, A met with an accident which caused him to lose 15 minutes on the road. At what distance from London will they meet?

This book should be returned to the Library on or before the last date stamped below.

A fine of five cents a day is incurred by retaining it beyond the specified time.

Please return promptly.

# Mathematical Books.

| | | INTROD. PRICE. |
|---|---|---|
| erly | Differential Calculus | $2.00 |
| | Integral Calculus | 2.00 |
| | Syllabus of Plane Trigonometry | .10 |
| | Syllabus of Analytical Geometry | .10 |
| | Syllabus of Analytical Geometry, *adv. course* | .10 |
| | Syllabus of Equations | .10 |
| ın | Addition Tablets { Pocket size | .25 |
| | { Large size | 3.00 |
| lsted | Mensuration | 1.00 |
| rdy | Quaternions | 2.00 |
| l | Geometry for Beginners | 1.00 |
| rce | Three and Four-Place Logarithms | .40 |
| | Tables, chiefly to Four Figures | .40 |
| | Elements of Logarithms | .50 |
| | Tables of Integrals | .10 |
| ldo | Multiplication and Division Tables: — | |
| | *Folio size* | .50 |
| | *Small size* | .25 |
| ntworth | Elements of Algebra | 1.12 |
| | Complete Algebra | 1.40 |
| | Plane Geometry | .75 |
| | Plane and Solid Geometry | 1.25 |
| | Plane and Solid Geometry and Trigonometry | 1.40 |
| | Plane Trigonometry. *Paper* | .30 |
| | Plane Trigonometry and Tables. *Paper* | .60 |
| | Plane and Spherical Trigonometry | .75 |
| | Plane and Spherical Trigonometry, Surveying, and Navigation | 1.12 |
| | Plane and Spherical Trig. and Surveying, with Tables | 1.25 |
| | Surveying. *Paper* | .25 |
| | Trigonometric Formulas | 1.00 |
| ntworth & Hill | Five-Place Log. and Trig. Tables (*7 Tables*) | .50 |
| | Five-Place Log. and Trig. Tables (*Comp. Ed.*) | 1.00 |
| | Practical Arithmetic | 1.00 |
| | Examination Manuals. I. Arithmetic | .35 |
| | II. Algebra | .35 |
| eeler | Plane and Spherical Trig. and Tables | 1.00 |

*Copies sent to Teachers for Examination, with a view to Introduction, on receipt of Introduction Price.*

**GINN, HEATH, & CO., Publishers.**

BOSTON. NEW YORK. CHICAGO.

*Presswork by Berwick & Smith, 118 Purchase Street, Boston.*